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MODEL AIRPLANE NEWS

All About U.S.S. Akron

Super-Light Wing Construction

Fokker D-7 Layout

JANUARY, 1932

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ey *Campania* 3-F (British) Seaplane on Torpedo Patrol—German *Brandenburgers* in Background

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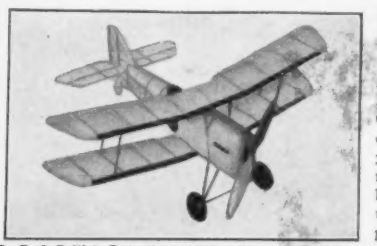

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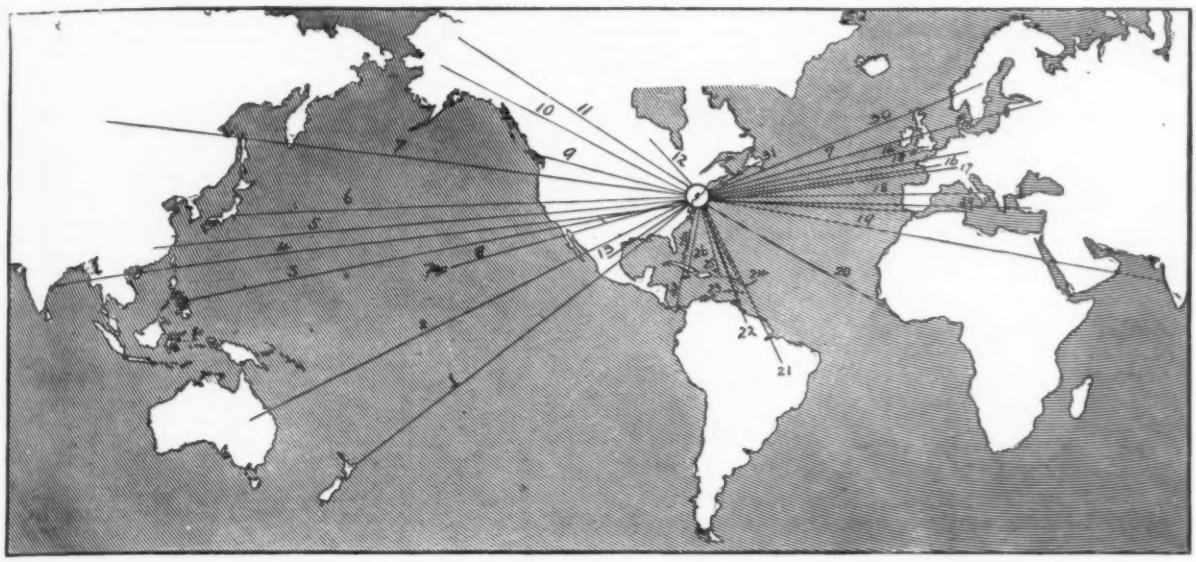

KEY TO NUMBERS ON THE ABOVE MAP

1. *New Zealand*
2. *Australia*
3. *Philippine Islands*
4. *India*
5. *China*
6. *Japan*
7. *Russia*
8. *Hawaii*
9. *Vancouver Island*
10. *Alaska*
11. *Yukon Territory*
12. *Canada*
13. *Mexico*
14. *Great Britain*
15. *Germany*
16. *France*
17. *Switzerland*
18. *Italy*
19. *India*
20. *West Africa*
21. *Brazil*
22. *British Guiana*
23. *Trinidad*
24. *Virgin Islands*
25. *Porto Rico*
26. *Jamaica, B. W. I.*
27. *Cuba*
28. *Canal Zone*
29. *Turkey*
30. *Sweden*
31. *Newfoundland*

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and JUNIOR MECHANICS

Vol. VI No. 1

Published by Harold Hersey

Edited by Capt. H. J. Loftus-Price

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In Our Next Issue

It is quite conceivable that to many of our readers the words "Trans-Atlantic planes" can refer to one only, and that is the "*Spirit of St. Louis*" — Lindbergh's plane.

However, Mr. H. J. Heindell, a prominent figure in the aviation world since before the Great War, reminds you in his article on "*Trans-Atlantic Airplanes*" that there were such great flyers as Lieut. Walter Hinton, the first American to pilot a plane across the Atlantic, and Capt. Sir Arthur Whitten-Brown and Capt. Sir John Alcock, of Britain, the first to make a non-stop flight across the Atlantic; and others of equal prominence. In addition, Mr. Heindell tells you of the planes themselves.

Then there are two sets of full-size plans. First, there are plans by Edw. Waldron, Supervising Principal, Union Township Board of Education, Union, N. J., for a "*Balanced Wing Model.*" Then Jack Clark, of Portland, Ore., has worked out a design of his own known as the "*Clark Cabin Model.*" Both these planes are worth every minute of your time in study and construction.

All these are in addition to the regular instalments of our great course on "*Airplane Engines*" by Lieut. H. B. Miller, U.S.N.; "*Aerial Radio*" by Capt. Leslie Potter, and "*Airplane Designing*" by Ken Sinclair; to say nothing of three-view layouts of war planes, etc.

February brings another great issue of Model Airplane News. Don't miss it. Make your reservation now. On all newsstands January 23rd next, and only 15c a copy!

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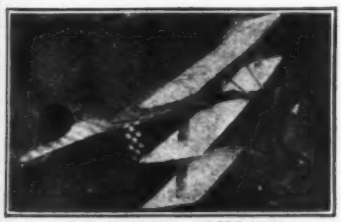

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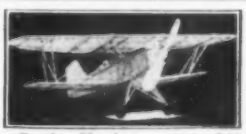

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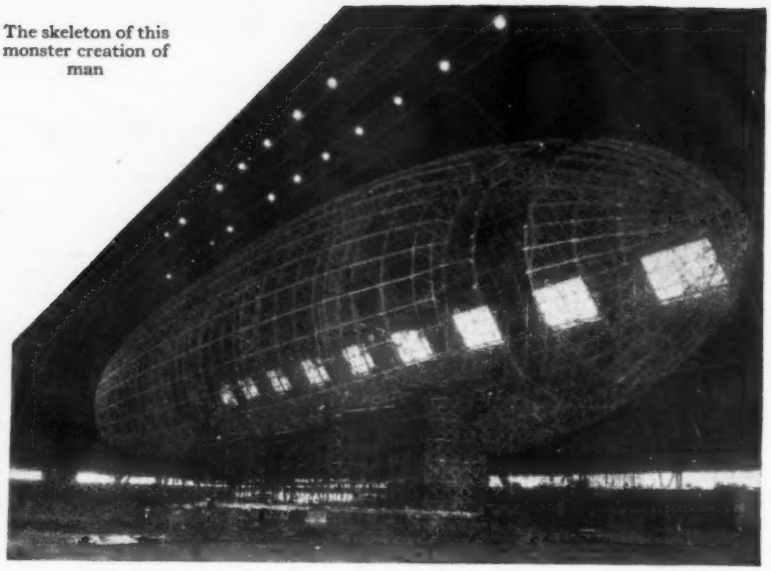
The skeleton of this monster creation of man



America's "Queen of the Skies"

By A. M. Toon

Behind the Scenes in the Construction of U. S. S. Akron

DOORS weighing six hundred tons each! Two pairs of them, opened and shut at a cost of one hundred dollars a time! Sounds like one of those "tall stories," doesn't it? But they are real doors, unlike any others in the world. A pair at each end guards the entrance to the mammoth structure erected at Akron, Ohio, by the Goodyear Zeppelin Corporation in which to build and house the largest airship in the world—the *U. S. S. AKRON*, now undergoing test flights.

The hangar, or dock, as they like to call it, as is fitting for such a huge occupant, is itself the largest structure of its kind, and is the largest ever built without interior supports. It was planned and built to hold ever a much larger ship than the *AKRON*. It can accommodate an airship of 10,000,000 cu. ft. gas capacity. The *AKRON* has a capacity of 6,500,000 cu. ft. and its sister ship, the *ZRS-5*, to be built later, will be the same size.

Approaching the dock, as it sits comfortably in the middle of its spacious field, you can but marvel at its size. You can have no idea of its proportions till you get inside. There are acres of concrete floor—eight and a half of them, or 364,000 sq. ft. The building is 1,175 ft. from end to end; not so much less than a quarter of a mile. It is 325 ft. wide. The arched roof has a surface of 693,000 sq. ft., and if the sheeting covering it could be laid out flat it would spread over eighteen acres.

Figures really convey so little meaning that it is only by comparison that yo ucan get any idea of the interior of this giant building. It will mean more to the reader to be told that ten football games could be played simultaneously on that immense floor; that if the Woolworth Building and the Washington Monument could be laid down side by side, there would be room and to spare; that the 211 ft. in height means that the hangar is as tall as a 22 story apartment house, and that through each of the twenty-four skylights could be passed an ordinary-sized dwelling.

More ingenious than anything else are the doors. To visualizze these, think of half an orange peel split down the midle, the top point being stationary, while the lower parts slide in opposite directions semicircularly till they can go no farther. It is thus that these doors are constructed. They are 202 ft. high, and 214 ft. at base. There is a track with rails weighing 100 pounds per yard each, which provides a sliding place for forty forged steel wheels which carry the doors open and shut.

The track is set like a railroad track and to the standard railroad guage, and is curved to fit the doors. The little double-flanged wheels are twenty-seven inches in diameter, and are spaced almost uniformly in pairs under the long curved sills of structural steel which form the base of the doors.

EACH wheel is separately mounted under boxes which rest against heavy springs. This equalizes the weight as the doors slide open or shut. This heavy weight must of course have a firm foundation. To this end a curved concrete runway was built, ten ft. wide, and deep enough to go below the frost line, on a series of concrete piles driven to solid rock. This track must be kept at the level of the dock floor and of the yard in front of it, for men handle the ships by hand with ropes as they are docked or launched. The tops of the rails are kept at the yard level while the bases of rails and ties are buried in the concrete foundation. Every precaution is taken for safety, for there must be nothing that men can trip over while handling the ship. It is estimated that the doors can be opened or closed in four or five minutes.

These doors are the first of this type to be built, the hangars at Lakehurst, N. J., and at Belleville, Ill., having vertical doors that open horizontally from the center out; and most of the hangars in foreign countries have the straight sliding type.

Dr. Karl Arnstein, director of engineering of the Goodyear Zeppelin Corporation and designer of the Akron dock, had tests made on a model 1/240th of the size of the real hangar. These tests were made to decide whether this type of building would offer a minimum resistance to wind cur-

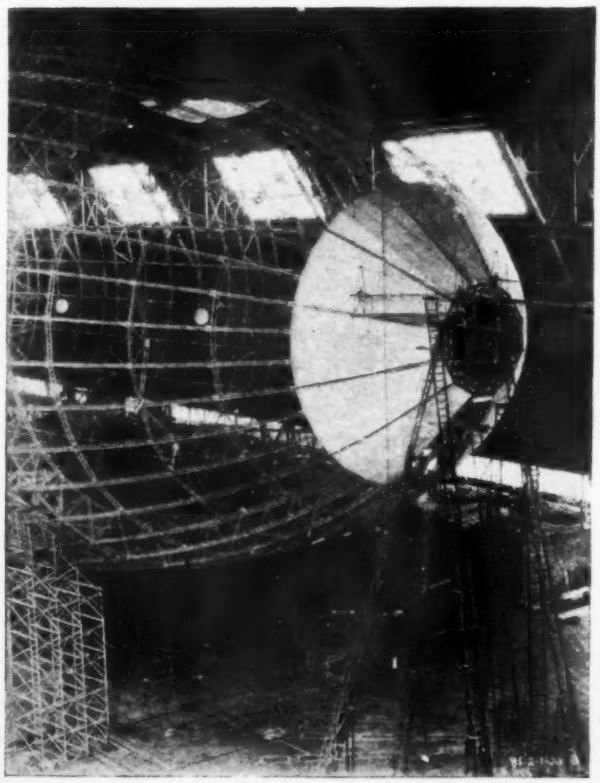
rents, and also to furnish information as to the magnitude and distribution of the suction forces caused by the action of the wind on the surface of the building. The proper position for the setting of the dock was found to be north 30 degrees east by south 30 degrees west, approximately.

The dock is equipped with many mechanical devices for handling working supplies, for it was primarily designed as an airship factory. Overhead in the center of the building are runways supported on the trusses, capable of carrying six ton electric hoists for moving material. There are working platforms which may be lowered or raised to any desired height and at intervals are placed fixed working platforms and "cat walks" two feet wide running the whole length of the structure.

Access to the upper platform is by means of two stairways and by a specially designed inclined railway for moving men and materials to the upper working platforms. This railways has two counterbalanced cars running on a curved track, shaped to the arch of the roof, the cars remaining upright all the time. Either car can be operated by one man, from the car itself, or from the upper platform, where the motors and drums for operating are placed.

Akron's home—note size of man indicated by arrow

UNDER the floor is a service tunnel, extending the full length of the building. This is built of concrete and contains electric outlets for both light and power, water lines, compressed air lines, and gas lines for inflating the gas cells. Of the 325 ft.—the width of the building only 240 ft. are really used for the assembling of the ships. This leaves space for shops and offices on either side of the hangar, (about 42 x 640 ft.)



Showing how fabric is attached to framework

THESE shops and offices are built entirely independent of the main building on account of the expansion and contraction of the main building frame. Fireproof construction is used throughout.

Men and teams worked months to prepare a field on which to build the dock. One million cu. ft. of earth was removed and used to fill in where needed to make a level site. Trees were uprooted and taken away, a cross-road was wiped off the map and a new one made further south. On the site itself soil was removed and a combination of selected gravel and clay was applied to the depth of six feet, deposited in 9-inch layers and each layer rolled.

Concrete footings for the arches laid on vertical and inclined piles driven to rock, and heavily reinforced ties laid across the building, help make up the substructure work. With the piles supporting the concrete door circles for the carriage of the doors, the total number of piles used is about 1,300, each carrying a maximum load of 30 tons.

The airships now being built at the plant will use only helium gas; ample provision is made for the storing. Helium is found in certain natural gas fields, the gas of which contains 2 to 4 per cent of helium, the balance of the gas being, mostly nitrogen.

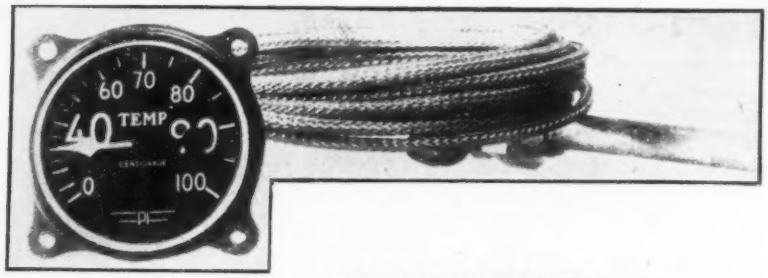
Helium is shipped from the field in small steel con- inches in diameter, each bottle containing about 170 cu. ft. of free gas under a pressure of 2,000 lbs. The ships now being built will require about 6,500,000 cu. tainers called bottles, about four feet long and nine ft. of gas each. The U. S. Navy has built and is now building special tank cars for the transportation of helium. Each car will carry about 600,000 cu. ft. of gas.

The Goodyear Zeppelin Corporation has installed a permanent railroad track parallel to the building, with a pump house near by, containing a compressor and a purification plant, and adjacent to this are underground storage cylinders having a storage capacity of over a million cu. ft. of gas. The purification plant is a necessity in order to remove any impurities which might mix with the helium and decrease its lifting power.

IT TOOK about seven months to build the dock, at a total cost of $2,500,000. Eight gangs of riveters were employed during most of the time of erection, and the total number of field rivets was 272,000; the average number of men employed for erecting steel was about 120.

When the last arches were placed, and the second set of doors finished and ready for operation, the Goodyear Zeppelin Corporation started to build the *AKRON*.

Even before the World (*Continued on page* 47)



Temperature gauge

The Airplane Engine

(*CHAPTER EIGHT*)

Instruments

By
Lt. (jg) H. B. Miller, U. S. N.

BY LISTENING carefully to his engine while it is running the normal pilot can judge whether or not it is operating properly. If his engine should slow down, he will detect it immediately. It is astonishing how quickly a well-trained pilot will respond to any different sound in his powerplant. It may be that he can see the propeller slow down, or it may be that he feels a difference in the vibration, but more probably his ear distinguishes a slightly different pitch in the noise which is emitted. As a matter of fact, a pilot of long experience can tell within fifty revolutions the rotating speed of his engine without the use of his instruments.

Nevertheless, no matter how well the aviator knows his engine nor how quickly he responds to a hesitant note within the powerplant, if he is to handle his engine intelligently, he must have and know how to use engine instruments. Many pilots have instruments mounted in their planes but never use them.

Each gauge clearly indicates some definite condition within the engine which should be clear to the pilot at all times. These dials permit the operator to diagnose nearly any trouble that may arise and will indicate to him whether he should land or whether he may continue his flight. They will tell him that he is operating his engine too lean with the result that eventually he will burn out his exhaust valves.

Instruments are the only reliable means the pilot has to accurately feel the pulse of his powerplant. He must observe the reading of the dials at frequent intervals in order that he may anticipate any engine trouble.

The airplane engine of today is very reliable. Perhaps the best feature of them is the warning they give a pilot before cutting out entirely. It is seldom that an operating engine stops without having given some previous notice. A pilot may be expecting trouble with one of his engines in which case he will keep close watch on his instrument panel in order to have time in which to take proper steps before it cuts out entirely. Unless an engine exhausts its gasoline supply, it will seldom fail on the moment.

With a judicious use of instruments the engine can be warmed up properly and in such a manner that long life is insured the powerplant. As an example, when warming up an engine it is essential that it not be turned up with open throttle too quickly because the oil may not be sufficiently fluid to pass freely through the lubricating system.

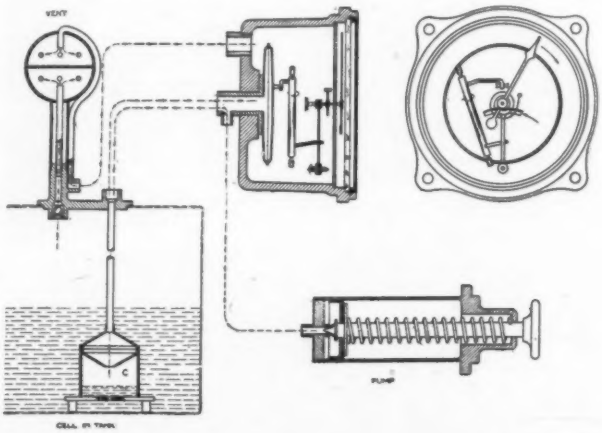
The powerplant must be turned over slowly until the oil temperature gauge indicates that the oil temperature is high enough to make certain that the bearings will be properly lubricated. Incidentally, this same point might be made of the automobile engine but few people give it more than a passing thought.

The number and variety of instruments an airplane engine should have depends on many factors. Foremost of these, of course, is the use to which the plane is to be put. If it is to take a night run over bad territory, it will necessarily have a more complete equipment than a small sport plane which will operate out of a good field only in favorable weather.

The average small ship can ordinarily operate satisfactorily with three engine instruments. A tachometer can hardly be dispensed with, for it indicates the revolutions the engine will turn over. This, of course, determines the power that it will develop. If the revolutions are distinctly down, something is wrong and the cause of it should be determined before the ship is flown; or it may be observed that as the time since overhaul increases the revolutions gradually fall off. When an engine has lost 100 or 150 turns it is again time for an overhaul. Thus, it is the tachometer which gives the pilot an understanding of the total power and efficiency of his engine.

PRACTICALLY all the other engine instruments indicate the conditions within one of the auxiliary systems. Of these, two are considered most important. The oil pressure gauge takes first place. No engine will operate without a good circulation of lubricating oil. Unless metal to metal contact is avoided and heat is carried from the bearings the temperature rise in the moving parts will expand them so much that they will "freeze" and stop the engine.

The pilot, then, must know at all times that he has a positive oil pressure built up within the lubricating system. The oil pressure gauge will tell him this. If, because of an oil leak or some other cause, the oil supply should become exhausted an alert pilot will observe a drop in the gauge



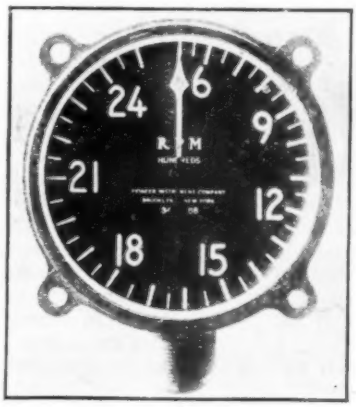
Fuel level gauge

reading. Thus, he will be able to land his plane before his engine is damaged.

THE third necessary indicator is the oil temperature gauge. Even this might be eliminated because it works hand in hand with the oil pressure gauge. However, one is a check on the other. If a drop of oil pressure indicates that only a small amount of oil is being circulated, the temperature of the oil will rise because less quantity of oil is being used to absorb the friction heat.

The small plane will ordinarily be equipped with a gravity feed fuel system so it will dispense with even a fuel pressure gauge. Not so the ship which is expected to fly cross-country with a load of mail or passengers. In addition to the fuel pressure gauge the pilot will want a fuel gauge to show him the amount of fuel he has available at all times. He will want electro-couples on his cylinders so that he knows exactly what temperatures the various parts of his engine are running.

On a route of this type the pilot will desire more instruments in order that he can diagnose trouble in greater detail, and also in order that he can anticipate engine difficulties much sooner.

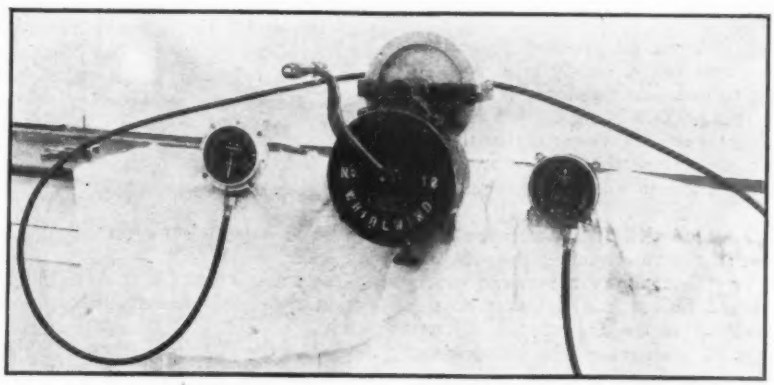


Tachometer dial

All instruments are mounted on a panel placed directly in front of the pilot where he will have the least difficulty in seeing them. Ingenious methods have been used in an effort to group the dials so that the operator can read them at a glance. Oftimes they are arranged so that when operating conditions are normal the indicating arms of all gauges will lie in a horizontal direction. Thus, the pilot's eye will be attracted more quickly to an arm which swings out of the horizontal.

Practically all figures and arms of modern instruments are painted with radium, in order that the pilot will have no difficulty when flying at night. It is very blinding for a pilot to look outside of the cockpit after looking at instruments that are illuminated with an electric lamp. It is much better for him to have a dark cockpit with radium dials for then the pupils of his eyes do not have to accommodate the different conditions of light.

There are many different types of tachometers, but for ordinary use the centrifugal tachometer is most popular. While not so accurate as other kinds, it is much simpler in construction and less likely to be in need of repairs. As we have seen before in discussing other parts of the airplane engine, simplicity in construction results in less initial and maintenance cost.


Gear for calibrating tachometers

In the centrifugal tachometer is mounted a vertical shaft which is driven by a rotating steel wire. By altering the length of the wire the instrument may be placed in a cockpit as far away as twenty-five feet from the engine. The wire is driven either directly off the crankshaft or by means of some intermediate tower shaft. In any event it is geared to indicate engine revolutions.

On the vertical rotating shaft are mounted two weights in such a manner that they may move in and out radially from the shaft. As the shaft rotates the centrifugal force throws the weights further apart. A spring is mounted to return the weights to their normal position. The position of the lever which operates the registering arm is dependent on the distance the weights are from the shaft.

Since this distance is dependent on centrifugal force or the rotating speed, the arm, therefore, indicates to the pilot the engine speed. In this connection, it is interesting to note that the centrifugal force is proportional to the square of the rate of engine speed. The dial, however, indicates engine revolutions per minute to the pilot.

The centrifugal tachometer is probably the simplest in construction. Further, it indicates closely the action of the engine. It is, however, subject to small errors from time to time. Nevertheless, its simplicity and ease of repair continue to place it in high favor.

Another well known type of revolution counter is the chronometric tachometer. Here a clock-like escapement mechanism is used and the revolutions are actually counted for a definite unit of time. The engine speed is converted to revolutions per minute on the dial of the instrument board. The escapement permits a gear to roll a rack which in turn is secured to the registering dial by a gear and arm.

The engine speed is indicated at the moment the unit of time, usually one second, is completed and the driving wheel is thrown out of gear. Three sets of racks are provided so that one begins operating when another has just finished. Because of this the indicator continually oscillates up and down and is to be read only when it has reached its maximum height.

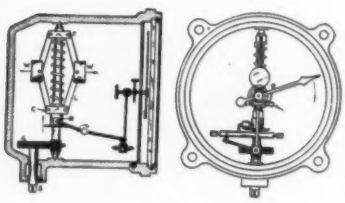
While the chronometric type is more accurate it is more expensive and complex. When out of commission it must be returned to a well-equipped instrument shop for repair. Moreover, it will not show a change in revolutions except at one-second intervals and it is to the pilot's advantage to know his engine speed at every instant. Because of these disadvantages this type of tachometer is no longer used to any extent.

There are many other types of revolution indicators. Among these is the electric tachometer in which the driving shaft rotates the armature of a small generator. The voltage output will be proportional to the engine speed. Hence, the cockpit dial will be a voltmeter scaled in revolutions per minute. This type of instrument has one very great advantage. Since the voltage will be carried by electric conductors the dial may be placed as far as is necessary from the engine without introducing any errors

in the reading.

Up to recently this tachometer has been very difficult to maintain in an accurate operating condition. Moreover, it was much heavier than other types. Much progress has been made along these lines of late, however, and their use will become more and more common.

The viscosity-type tachometer is well known. In an airtight chamber a flat disc is rotated by the engine shaft. A short distance from this is a second spring-balanced disc on which is mounted the recording arm. Either air or some substance such as mercury is used to fill the chamber.

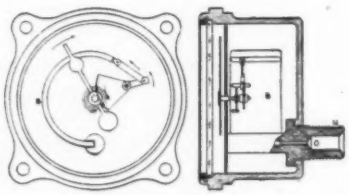


Tachometer

As the engine-driven disc revolves the viscous quality of the separating layer will tend to drag the spring-balanced disc around. As it does the arm will record the amount of drag or the engine speed on the front of the instrument dial.

There are many other types of tachometers such as the magnetic, liquid centrifugal, commutator-condenser, and the friction-disc. However, for simplicity and reliability the centrifugal tachometer is selected for use in the majority of powerplant installations.

The oil pressure gauge certainly stands second in importance of the many engine instruments. No engine can operate without proper lubrication. No matter what the cause of the loss of oil the result will be the same—a "burned out" engine.



Pressure gauge

The powerplant may have been in service for some time, resulting in worn piston rings. Considerable oil is then apt to pass into the combustion chamber and be consumed. The pilot may have no knowledge of this except perhaps a smoking exhaust. A leak may occur in the oil tank or in the oil line. Fortunately, in this case the pilot's goggles will generally collect some drops of loose oil which will lead him to suspect that he is losing oil.

IN THE end, however, it is the oil pressure gauge that indicates to the pilot that his oil supply is so reduced that the pump is unable to maintain the desirable oil pressure. No longer is the friction heat being carried away to the atmosphere. It becomes absolutely essential that the engine be stopped immediately before the concentrated heat within the bearings melts them down and destroys their usefulness.

Naturally, a forced landing results. If an acceptable landing field lies just beyond the normal gliding distance, the engine may be used at very short intervals between which, however, the switch should be cut in order that no unnecessary heat is released within the engine.

Like any other piece of mechanism the oil pressure gauge may become inoperative. Suppose this happened. A forced landing under the most favorable conditions is something to be avoided. Some sort of a check should be provided in order that the pilot can be certain he has actually lost oil pressure.

Fortunately, the oil temperature gauge provides a ready means for confirming the oil pressure as shown on the gauge. If the pressure is actually low, a smaller volume of oil is passing through the lubricating system. To this smaller quantity is given the task of carrying away the heat that was formerly handled by the larger volume of oil. Consequently, the oil temperature will rise very quickly to a high degree.

The pilot, then, who observes his oil pressure drop will wait for an instant for his oil temperature gauge to verify this. If the temperature fails to rise, the pilot will continue his flight, though he will keep a close watch on his instrument board. He should also land at the first airport and check his supply of oil in order to confirm his conclusions.

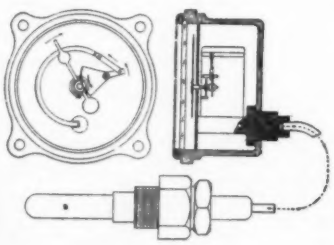
A LINE is lead off from the oil system directly after the oil pump. This conveys the hydrostatic pressure of the pump to the gauge which is mounted in the cockpit. The mechanism of the gauge consists simply of a Bourdon tube. This is a circular brass tube which has an oval-shaped cross section. One end of the tube is closed while the other end is soldered to the oil lead and so receives the hydrostatic pressure. To the closed end is secured a small wire or chain which rotates the indicator arm against a small hair spring.

When pressure is built up within the Bourdon tube it will tend to distend or to increase its cross-section area. As a result of this the tube will attempt to straighten out which results in a distinct movement of the closed end. This actuates the indicator arm and moves it around the dial which has been calibrated in pounds per square inch. The spring will return the arm when the pressure falls off.

It is interesting to note that the oil line leading from the engine to the pressure gauge must not be too long or be led in an exposed position. This installation would permit the oil to cool off and it would fail to give an accurate reading.

The thermometer is a valuable instrument to the pilot. In the water-cooled engine the water thermometer will indicate the thermal condition of the engine. The two extreme cases of this are, of course, boiling and freezing.

In the air-cooled engine only an oil temperature gauge can be provided for the pilot's information. However, an intelligent use of it makes it all that is necessary. This instrument will permit the engine to be warmed up slowly enough to insure good lubrication at all times.



Temperature gauge

It must be remembered that if an engine is turned up fast before the oil has had a chance to warm up and become fluid, the pump may be unable to get a suction on the thick, viscous oil. Accordingly, proper lubrication within the bearings melts them down and destroys their result.

One of the most widely used thermometers is the vapor-pressure type. It is made of the Bourdon tube in a fashion quite similar to that in the pressure gauge. The Bourdon tube is connected by means of an airtight line to a bulb which is inserted in the system of which the temperature is desired.

The bulb is partially filled with some liquid such as ethyl chloride or sulphur dioxide. As the liquid heats up it will form a vapor which will have a definite pressure proportional to the heat which is applied. This vapor pressure will then actuate the Bourdon tube and the dial will indicate the temperature in (*Continued on page* 44)

A 1/48th Solid Scale Model

of the

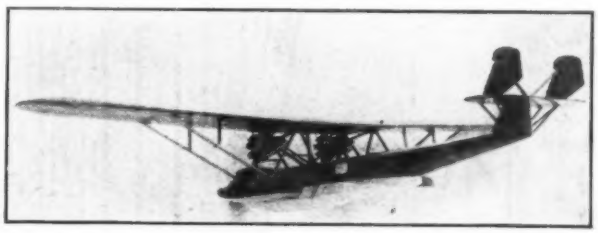
Consolidated *Commodore*

By

Jesse Davidson

HERE is a scale model different from the many types which have appeared before in this magazine—the Consolidated *Commodore*, a commercial flying boat. A word or two about this ship of which you are about to make a model will be interesting.

The *Commodore* is one of the latest types of air-going boats. It is powered with two Pratt & Whitney *Hornet* engines, giving the ship a total of 1,150 horsepower. It cruises at 100 m. p. h., and has a top speed of 125 m. p. h. These types of boats are used chiefly over water routes of the New York, Rio, Buenos Aires Lines and of the Pan-American Airways line, which operate along the South American coast and the Caribbean ports. The *Commodore* has a wing span of 100 feet and is capable of carrying twenty passengers.



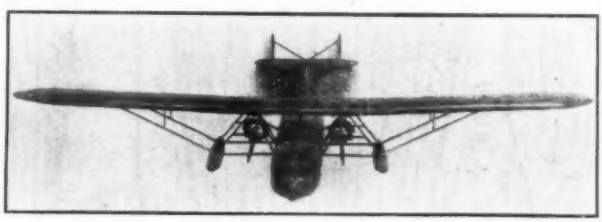
Finished model—three-quarter rear view

HULL

The kind of wood you wish to use for the construction of the hull is optional. Soft white pine, bass or balsa are suggested. You will need a block 2″ x 2½″ x 15″. The side view of the body is traced from the plans and pasted on each side of the block. The shape is then cut out.

You will notice there are two steps which must be cut with care (watch your "steps!"). The bottom of the hull is V-shaped with a slight concave at the outer tips. A tracing of the top view is then pasted on the top of the block and then the streamline shape cut out. (Note: The dotted lines shown in the drawings show the shape of the step as seen from below).

The top part of the hull is next rounded off as illustrated. The pilot's compartment is a built-up frame of 1/16″ square wood. The sides are covered with sheet balsa. Celluloid is used for the windows. The hull is then finished off by sandpapering.



Finished model—front view

WING

The wing is made in one piece but is later cut in three sections. A piece of the wood selected, ½″ x 3″ x 26″, is needed. First trace out your wing on the smooth upper surface of the board. Cut all excess wood until you are even with the outlines of the wings. Next round off the wing tips. Finish off with sandpaper.

The airfoil section employed in the *Commodore* is a Gottengen "398." To give your wing the cambered shape use a small block plane or a sharp knife. In making the wing be sure the whole top part is perfectly even, save toward the wing tips where it tapers down as shown in the drawings. After the whole wing is completed, the center section is outlined with a sharp pencil, then it is cut from the wing with a coping saw. Now the right and left halves must be set at a 3/8″ angle of dihedral.

Ambroid or any other strong glue may be used. Apply it on both sides of the center section and on each side of the half wings. Press firmly together and allow to dry for at least four or five hours. The dihedral can be made by putting little blocks of wood ⅜″ in size at the tip end of the wings.

EMPENNAGE

THE empennage, or tail group, consists of the rudders, elevators, fins, etc. The pattern of each surface is traced from the plans onto the wood which should be ⅛″ thick. The rudders and vertical fins are made in one piece, as are the elevator and stabilizer. If desired, they may be cut apart and hinged together so they can move freely.

For the large horizontal stabilizer use a piece of wood ⅛″ x 2″ x 6″. This is cut out, edges rounded off, and then streamlined as illustrated in the plans.

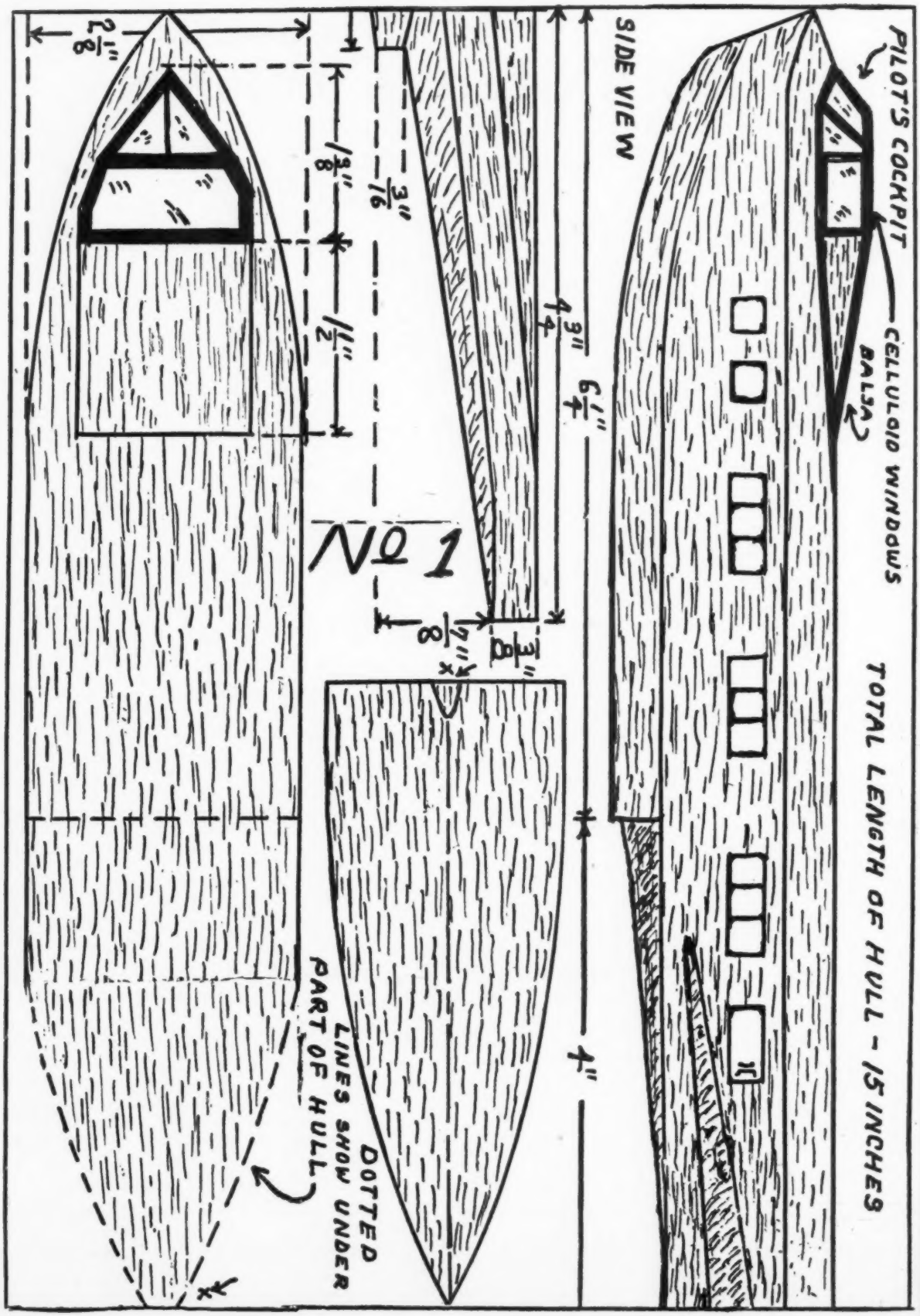
The rudders and vertical fins are made next. They are cut out of a single piece of wood ⅛″ x 1½″ x ½″. These are made in the same manner as is the horizontal stabilizer. There are two rudders.

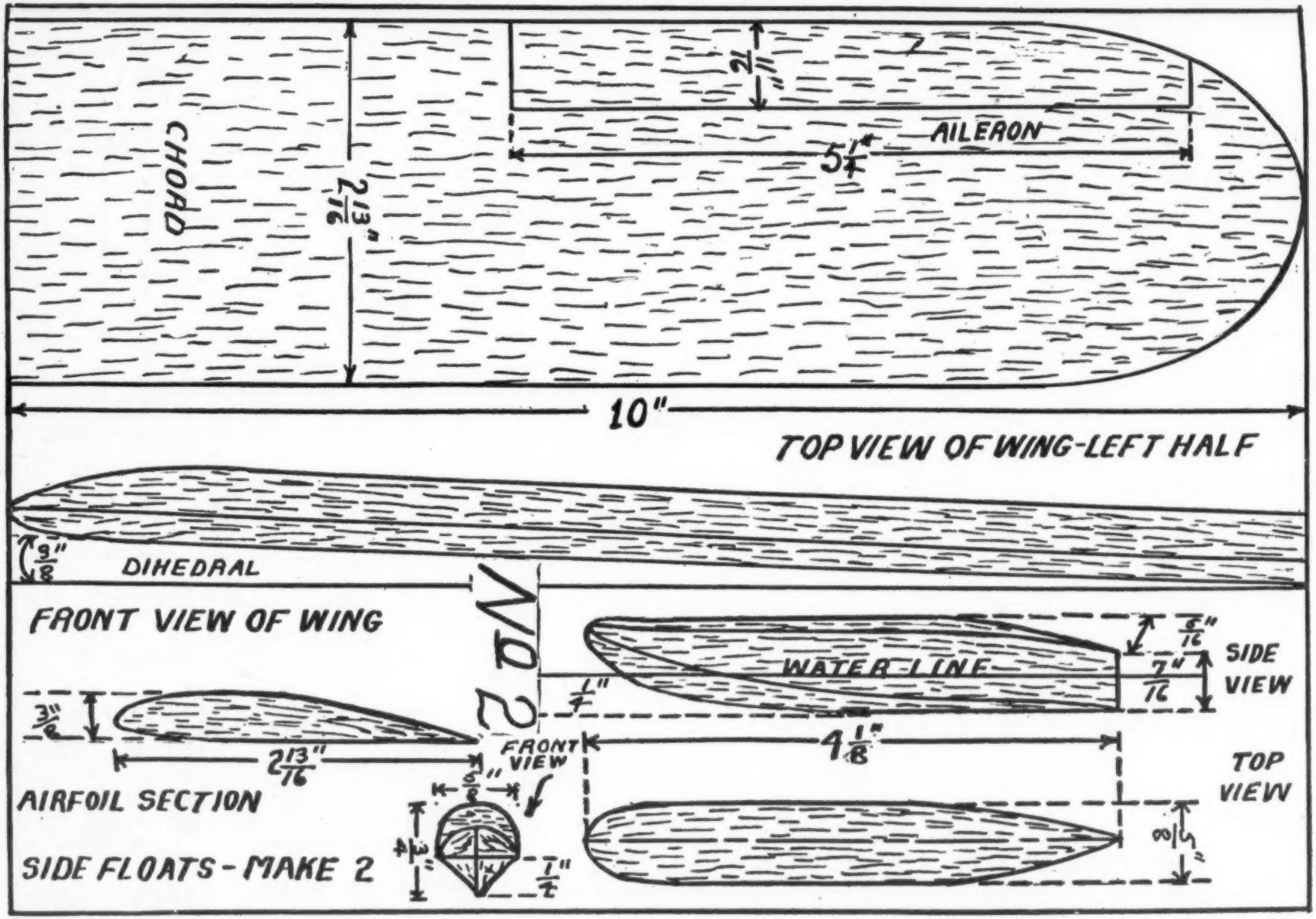
The main vertical fin as shown in the drawing is cut from wood ½″ x 1″ x 1½″. Note that it is thick at the bottom and tapers to 3/16″ at the top. A slight hollow is then cut out at the top to allow the horizontal stabilizer to set in. The vertical fin is also streamlined.

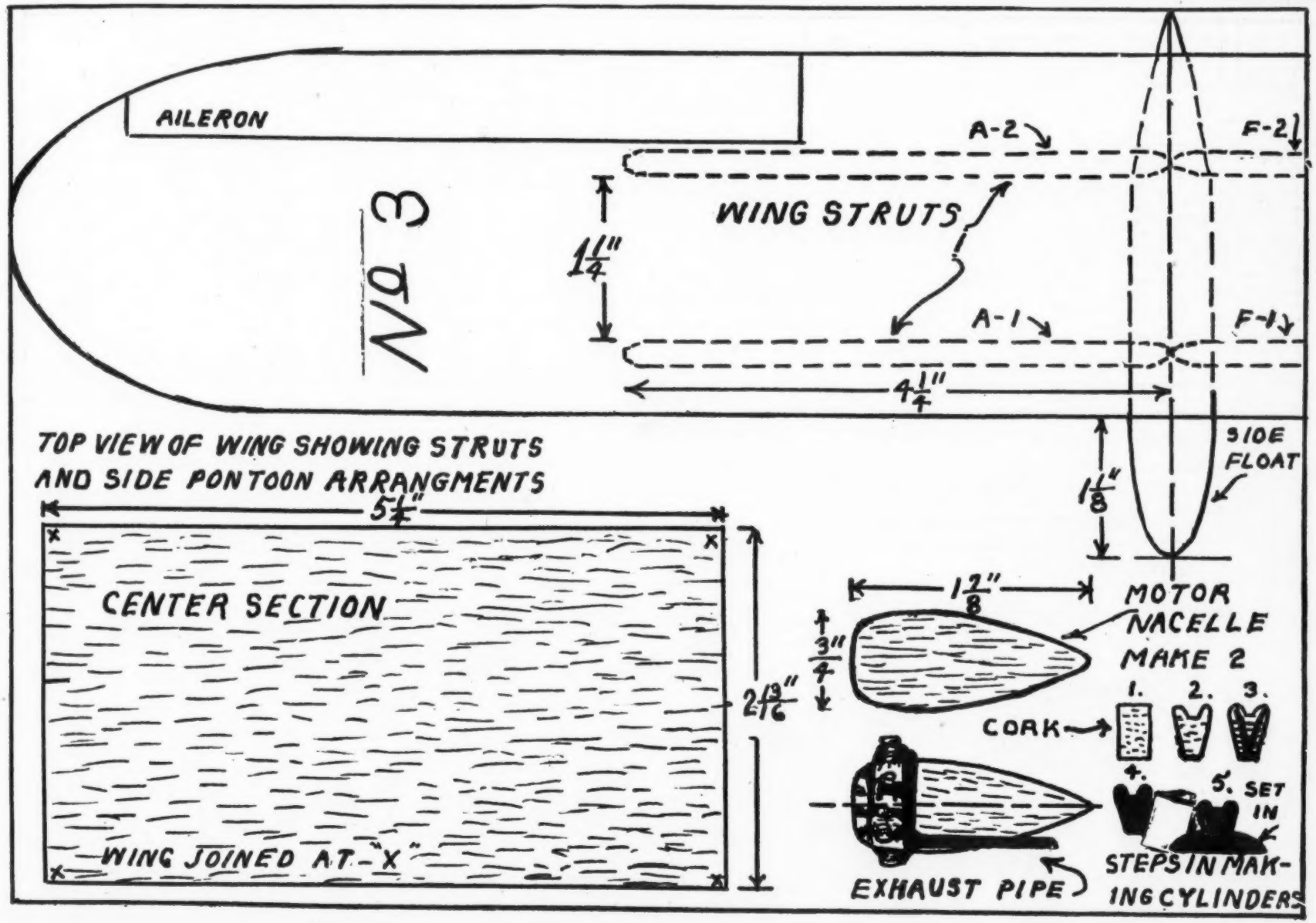
MOTORS AND NACELLES

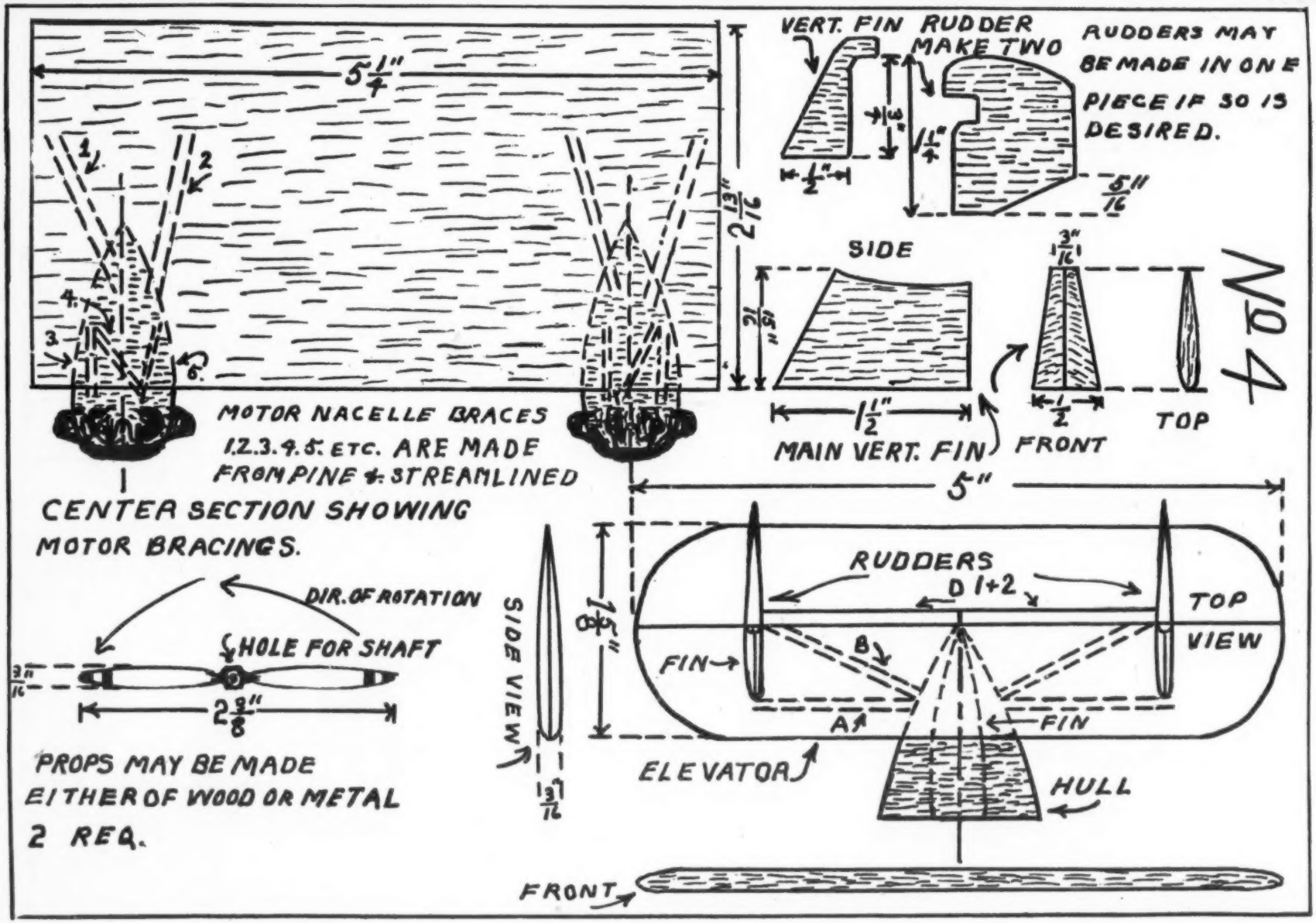
The nacelles to which the motors are built around are cut from blocks of wood 1″ x 1″ x 2″. Two blocks are required.

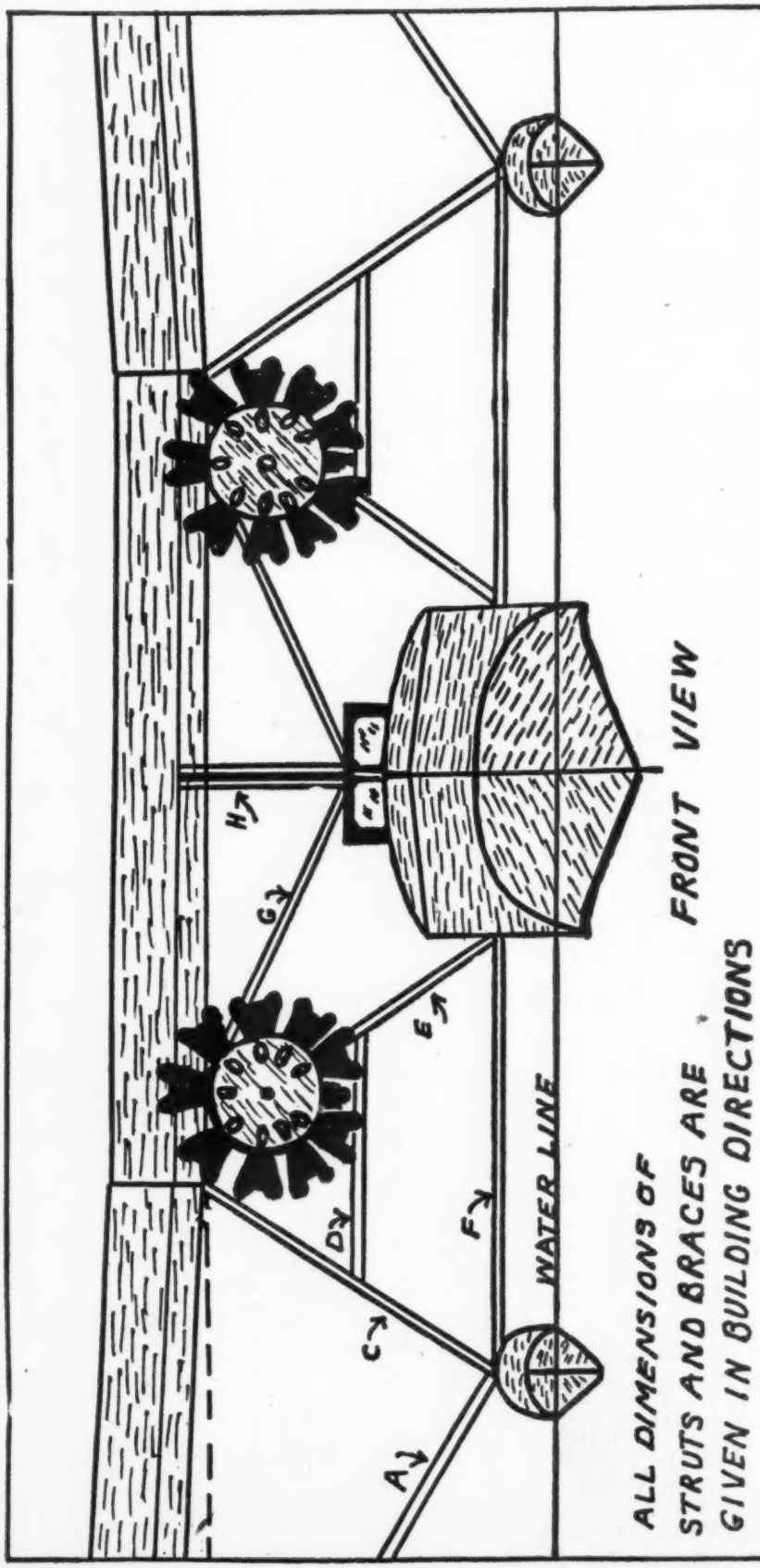
The nacelles are of streamlined (*Continued on page* 14).


PILOT'S COCKPIT
CELLULOID WINDOWS
BALSA
SIDE VIEW
TOTAL LENGTH OF HULL - 15 INCHES
4"
6 1/4"
4 3/4"
2 1/8"
1 3/8"
1 1/2"
3/16"
NO 1
1/8"
3/8"
1/2"
LINES SHOW UNDER
PART OF HULL
DOTTED


CHORD
2 13/16"
2 1/2"
AILERON
5 1/4"
10"
TOP VIEW OF WING-LEFT HALF
9/8" DIHEDRAL
FRONT VIEW OF WING
3/8"
2 13/16"
AIRFOIL SECTION
NO 2
FRONT VIEW
5/8"
4 3/4"
1/2"
SIDE FLOATS - MAKE 2
WATER LINE
5/16"
7/16"
SIDE VIEW
1/4"
4 1/8"
TOP VIEW
8 1/2"


AILERON
No 3
A-2
F-2
WING STRUTS
1 1/4"
A-1
F-1
4 1/4"
TOP VIEW OF WING SHOWING STRUTS
AND SIDE PONTOON ARRANGMENTS
5 1/4"
CENTER SECTION
WING JOINED AT "X"
2 13/16"
1 1/8"
SIDE FLOAT
1 2/8"
MOTOR NACELLE
MAKE 2
3/4"
1. 2. 3.
CORK
4.
5. SET IN
EXHAUST PIPE
STEPS IN MAKING CYLINDERS


5 1/4"
2 13/16"
1
2
3
4
5
6
MOTOR NACELLE BRACES
1.2.3.4.5. ETC. ARE MADE
FROM PINE & STREAMLINED
CENTER SECTION SHOWING
MOTOR BRACINGS.
DIR. OF ROTATION
HOLE FOR SHAFT
3/16"
2 9/16"
PROPS MAY BE MADE
EITHER OF WOOD OR METAL
2 REQ.
VERT. FIN RUDDER
MAKE TWO
RUDDERS MAY
BE MADE IN ONE
PIECE IF SO IS
DESIRED.
1 3/4"
1/2"
5/16"
SIDE
1 5/8"
1 1/2"
MAIN VERT. FIN
3/16"
1/2
FRONT
TOP
NO 4
5"
1 5/8"
SIDE VIEW
3/16"
RUDDERS
D 1+2
TOP
VIEW
FIN
B
A
FIN
ELEVATOR
HULL
FRONT



form. Cut them out from the blocks, streamline and round off as illustrated. After they are completed the cylinders must be put on. Each cylinder is made from small pieces of cork with soft copper wire entwined around to imitate the flanges on the real ones. If desired they can also be turned from wood or metal.

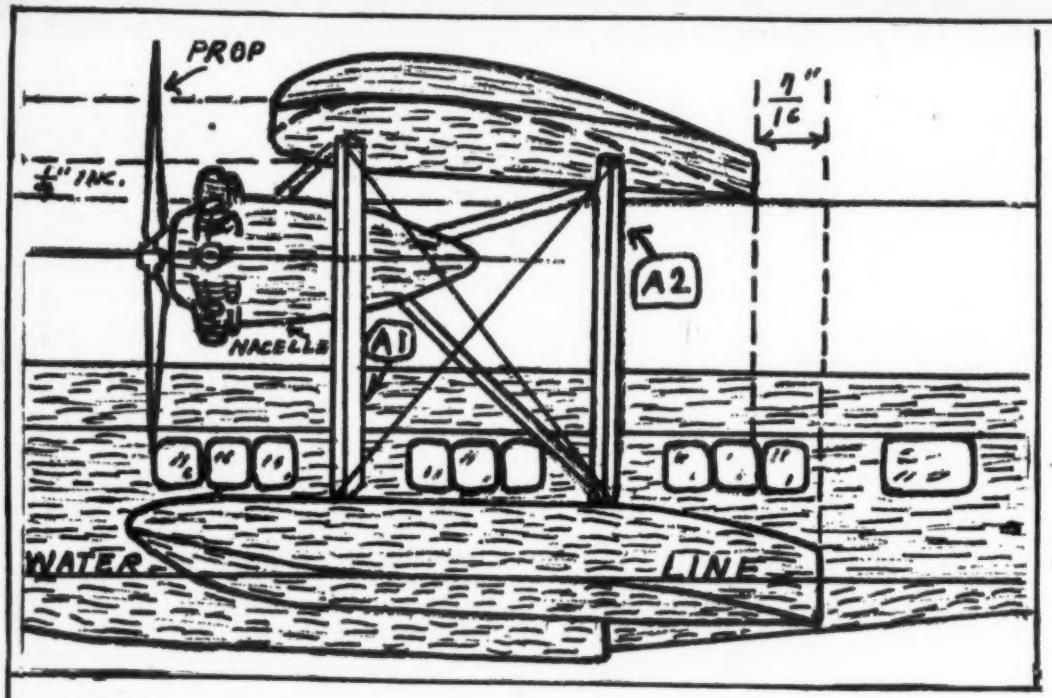
Nine cylinders are placed around each nacelle and glued. The exhaust pipes are made from soft wire 1/8" diameter which is placed around the rear of the cylinders, a part extending along the lower side of the nacelle. This completes the motors.

The small pontoons on each side of the hull are used to keep the wing from coming in contact with the water as in the real plane. On the model they are made from blocks of wood 3/4" x 3/4" x 4 1/2". They, too, are cut out after being traced from the plans. They are of V-shaped bottom and streamlined. Care should be taken to have both exactly the same.

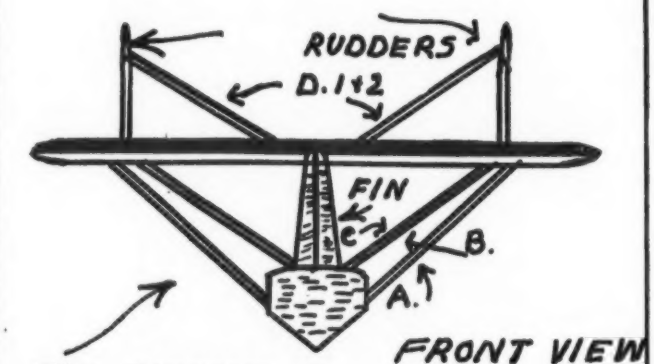
The propellers are made from hard or soft pine wood. Two small blocks 1/4" x 3/16" x 2 3/8" are needed. Cut to shape with a sharp knife and finish off with smooth sandpaper. Both props are made to rotate in the same direction, that being counter clockwise or spinning to the left. A small hole is drilled in the exact center of the hub to accommodate a pin for the propeller shaft. Make your props of steel or any other metal.

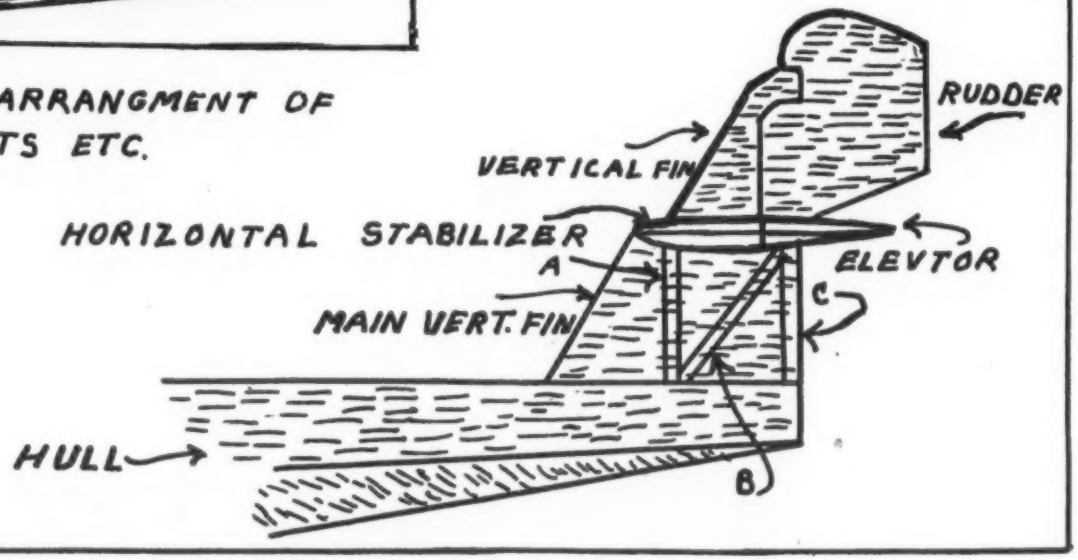
All the little nacelle braces are cut to the dimensions as listed below. Notice that in the drawings they are identified by numbers—1, 2, 3, etc. These braces are made of 1/16" diameter dowling. Brace 1 is 1" long, 2 is 1 1/4" long, 3 is 1/2" long, (*Continued on page 42*)

No 5



SIDE VIEW SHOWING THE ARRANGMENT OF SIDE FLOAT, MOTOR, STRUTS ETC.





9 of V

America's Ace of Aces

By
L. ELSEN

Speed, Coolness and Courage Made "Eddie" Rickenbacker a Hero of the Air

IT WAS inevitable that the entry of America into the World War in the spring of 1917, should attract the youth of this country. They came from every walk in life, the vast majority ignorant of the smallest rudiment of military training. Each man had to be groomed in as thorough a fashion as the urgency of the situation, and instead of the breath-taking thrills they had anticipated, they learned that the game of war is a serious business.

One of the hardest task-masters was the aviation corps. Not only did it call for every ounce of reserve stamina under endless danger, but it demanded quick thinking and coolness in the most hazardous of undertakings, courage against tremendous odds and skill in out-thinking and outwitting the other fellow.

Most of America's airmen of that time had to be taken in hand as raw recruits and taught everything about aviation. One of these was Edward V. Rickenbacker, later to become America's premier war ace. He brought with him, however, a training which was invaluable and was to serve him well in aerial battles. At the time he was at the fore in the American sporting world as a daredevil automobile racer—and the ability of thinking quickly, a great disregard for danger, and the capacity for tremendous speed were his assets for a life in the air.

"Rick" as he is today

He had had a number of years at racing, having gone directly from the public schools of Columbus, Ohio, to the automobile racing tracks. In the spring of 1917, at the age of twenty-eight, he was in England on a mission in connection with his work. Immediately that America aligned herself with the Allies, Rickenbacker determined to enlist in the aviation branch of the service and organize an American flying squadron composed of his fellow automobile-racers.

The plan did not progress, however, and he abandoned it for the time being. Then on the invitation of General Pershing to become his official chauffeur, Rickenbacker enlisted and set out for the war front. He bided his time and waited for the chance to enter the air corps.

At last it came. After several months with General Pershing, and one month's training at the Cazeau Gunnery School, he was ready and in March, 1918, he left for the airdrome as a member of the new 94 Squadron, soon to become famous as an aerial fighting unit.

The veteran Raoul Lufbery had been drawn from the Lafayette Escadrille to train the squadron, and it was to him that Rickenbacker came for tutelage in aerial tactics. Major Lufbery took the tall, thoughtful Rickenbacker in hand and even accompanied him on his first flight over the lines. It was a slow process, as Lufbery was ever the careful tactician and he meant to install in his pupils the virtues of patience and practiced skill.

Rickenbacker was cautious and level-headed and learned much of the master fighter's methods. Then his plane was fitted with armament and on April 10, 1918, the squadron flew their *Nieuports* to their new home, an airdrome near Toul.

It was then, on the suggestion of several members of the squadron, that the famous *Hat-in-the-Ring* insignia was adopted.

Rickenbacker had to wait until the early morning of April 29, for his first victory. He went out with another flyer on patrol and much to their own surprise, they found that they had bagged an enemy plane. They had come upon a new *Pfalz* machine and while his companion fired, Rickenbacker edged on the other side of the enemy and cut off his avenue of escape. The German abandoned all fight at the attack and dived for home, as had been expected of him. Then Rickenbacker fired at 150 yards range into the rear of the *Pfalz* and sent it crashing down at the edge of some woods a mile inside the German lines. Not one shot had been fired at Rickenbacker during all these aerial maneuvers.

HE WAS now leading the No. 1 Flight of the squadron, and acting captain which virtually made him second in command of the squadron. On May 17, 1918, he went out to observe the enemy's stronghold, the celebrated fortifications at Metz. Then on to Thiaucourt he flew and happened on three powerful, single-seater *Albatros* machines. They were unaware of his presence and he went in pursuit of them. He was less than 200 yards from the last plane before he fired. Without abating the terrific diving speed of 200 miles an hour of his *Nieuport*, he swooped down on the enemy and sent it fluttering to earth.

However, Rickenbacker soon found himself in an unenviable position. Almost simultaneously with the downing of his victim, he found that he was being tailed by the other two machines. In a violent effort to zoom, his machine, a *Baby Nieuport* single-seater fighter equipped with a Gnome Monosoupape motor, and never too strong

for maneuvering, suddenly ripped its wing. It turned over on its right side and down he went in a tailspin, the two machines behind firing continuously. As he fell, seemingly doomed, the enemy planes left the field.

Rickenbacker seized his opportunity. With a last violent effort, he managed to bring his plane up straight and at last slid over the line, a good 1,000 feet up. A nasty experience—and a narrow escape!

About one month's time brought four more victories over the enemy and awarded the enviable title of "Ace" to Rickenbacker. Two *Albatros* fighters and two biplanes of the same kind had gone down before his lone attack. Now he became more daring. Higher and higher into the skies he would climb, early in the day, for the joy of swooping down on the unsuspecting venturer into forbidden territory.

A wartime photograph of Rickenbacker standing at the nose of his *Spad*

However, the intense cold at such great altitudes caused an ailment of his ear and he was forced to go to a Paris hospital for treatment and recuperation. He was discharged early in July and given a new French *Spad* machine. Unfortunately, his career as a fighter was again interrupted with an attack of fever and he was out of the fight a second time. Then he flew back to the airdrome near Chateau-Thierry to which the American fighting squadrons had been transferred.

September 14, brought his next victory. It was during this time that Lufbery was killed, and Rickenbacker led a flight of flyers over the grave and dropped flowers on it in homage to the man who had so carefully trained them to carry on.

The distinction of squadron commander was then accorded Rickenbacker on Sept. 24, 1918. He was now Acting-Captain of the first American aerial unit to go over the lines, as the official title of Captain had not yet reached him. Seven victories were now his total.

From that moment Rickenbacker began marshalling his forces, planning ahead for the achievements of his squadron just as a methodical business man would go about a campaign for greater sales. He was determined that the 27 Squadron, which had of late been threatening to surpass the record of the *Hat-in-the-Ring* Squadron, should be left behind by the victories of his own command.

The very first morning of his new responsibility, September 25, Rickenbacker went up and returned within a half-hour with two more victories to add to his own record. It is worthy of an account here.

HE WENT up alone in the direction of Verdun and then on toward Etain. Beneath him he spotted two *L.V.G.* two-seaters with five protective *Fokkers* above them, veering in the direction of the American lines, Rickenbacker resorted to his favorite maneuver and zoomed into the sun so that he was unobserved. Then he dived for the nearest *Fokker*, one in the van of the formation. The German saw the American but not before the sights were already trained on his machine. Bullets charged into the plane and the pilot was killed instantly, the plane crashing immediately.

Then Rickenbacker plunged headlong through the formation, flashing past the four remaining Fokkers, and heading for the *L.V.G.'s* in front. The *Fokkers* were so taken back by the sudden charge that they bolted away, to safety. Down Rickenbacker went, the steady fire of the *L.V.G.'s* gunners on him. He dived under the nearest machine and came up again. The other *Fokker* in the meantime had dodged to the rear of Rickenbacker's machine and was firing repeatedly, though without effect.

Rickenbacker managed to slip out of range and came back again to his first quarry. On and on they went, stalking each other like beasts of prey, waiting for the little slip that would mean victory for one and defeat, and possibly death, for the other.

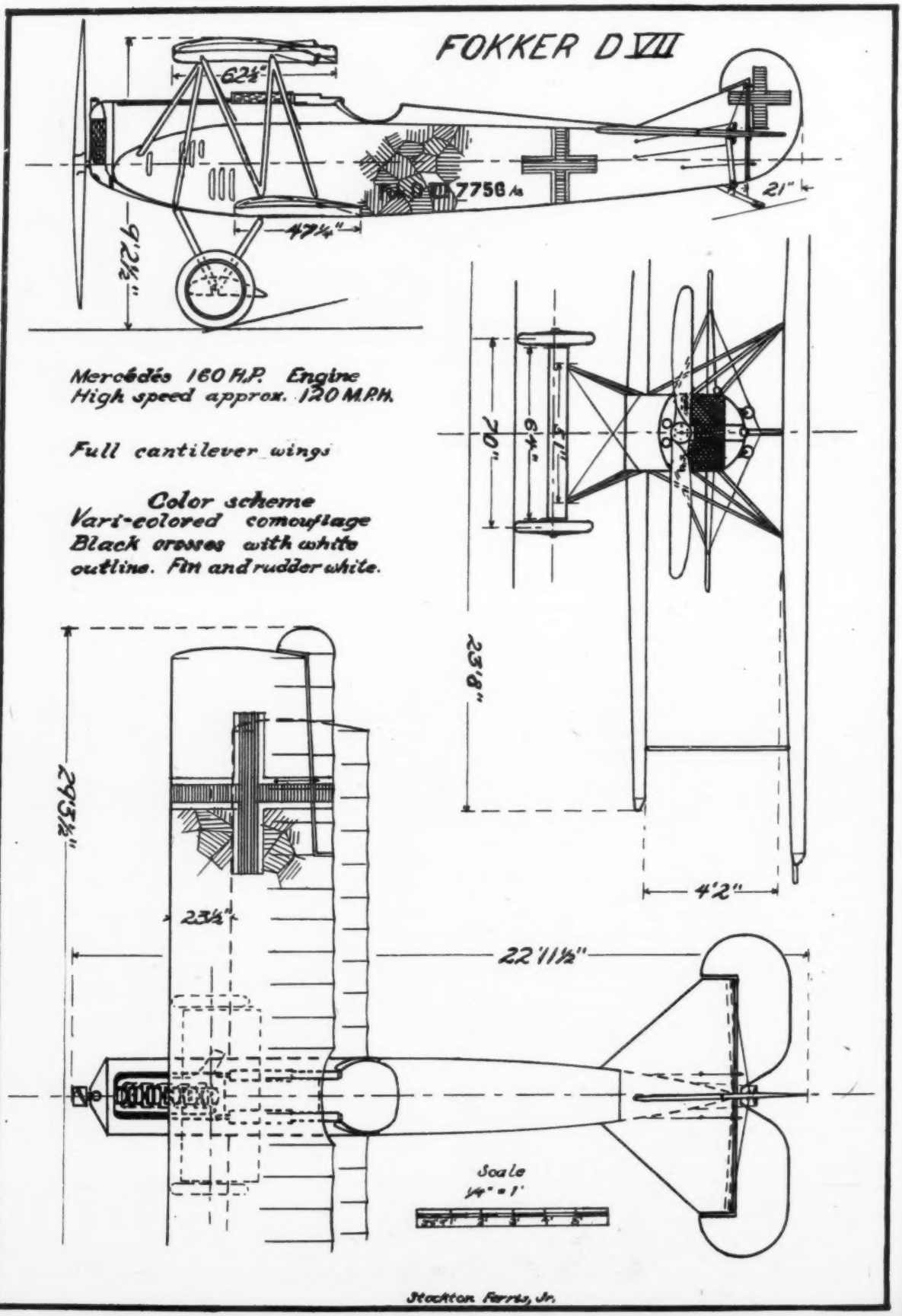
AT LAST the American seized his chance. The Germans were flying side by side, not even fifty yards apart, and Rickenbacker went into action. He side-slipped until one *Fokker* was between him and the other, and let go a burst of fire. The nearest machine took fire. The other spun to earth like a leaf in a storm.

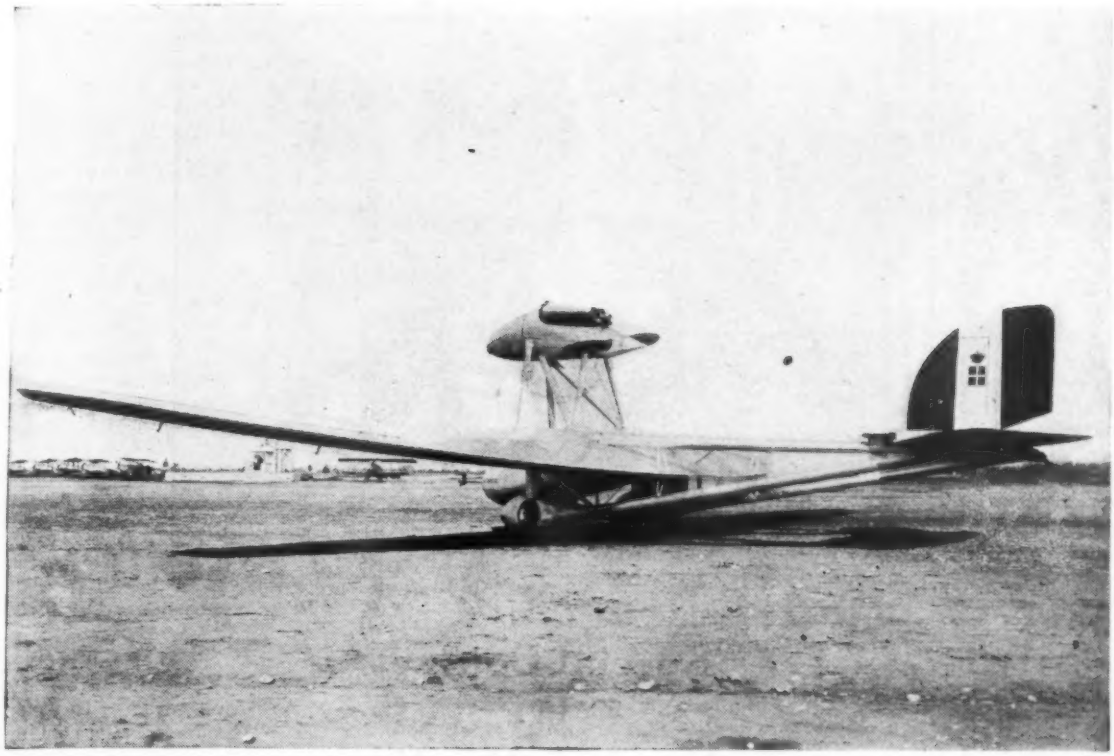
The victor then made for home with the news of his first double victory, which was later verified officially in the customary way.

So the game of hide-and-seek with death went on. Rickenbacker, cautious, hard-working and steadier than the young men under his orders, was an ideal leader. It was he who planned their individual and collective sorties, and an account of the brave showing of the 94th Pursuit Squadron under his command deserves more than a few words here. To fully appreciate those men and the conditions under which they accomplished so much, one can do no better than to read Rickenbacker's own story of his war experiences, "*Fighting the Flying Circus*," in which he pays great tribute to the *Hat-in-the-Ring* Squadron.

Not only did Rickenbacker guide the activities of his squadron by carefully studied plans of operations, but also every day he was adding to his record of personal victories. In the first month of his duties as commanding officer, he added eighteen victories to his list. Whenever he could safely relegate the hampering details of administrative duties, he would take off and go "fishing" in the air on his own.

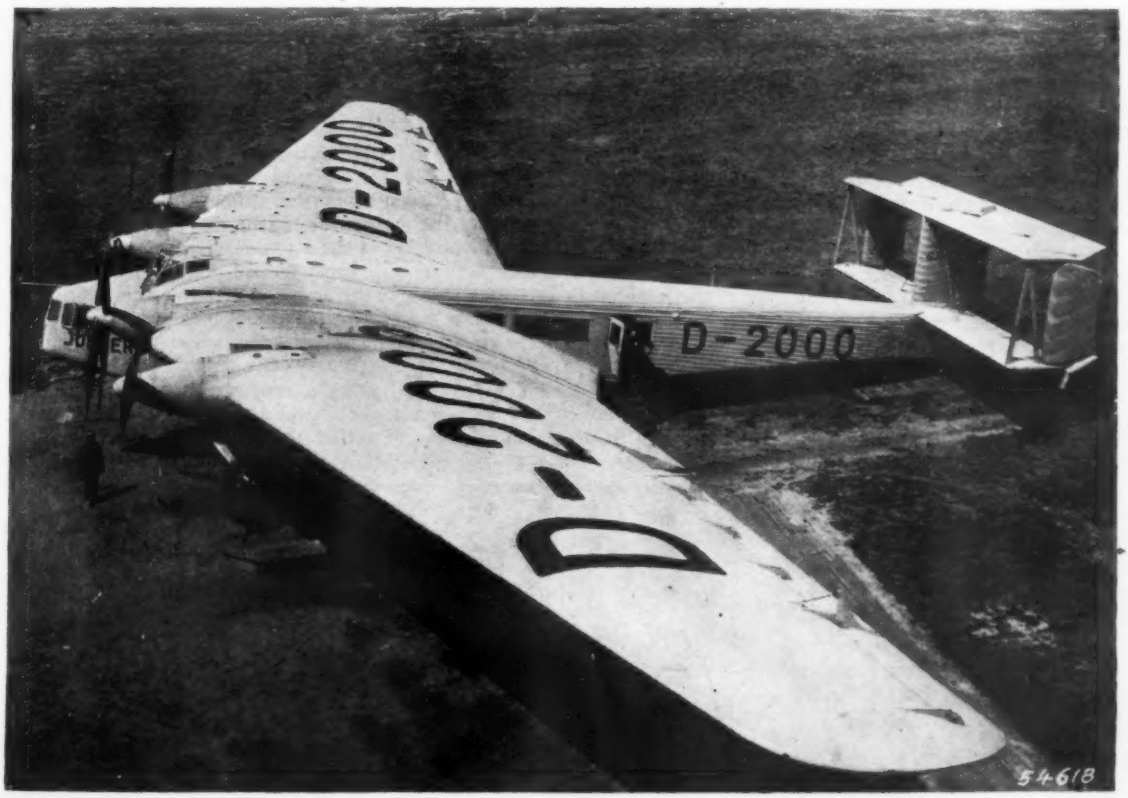
Once his bait almost turned the tables on him. In October orders were issued that 94 Squadron was to patrol the lines at a low altitude in order to meet the low-flying enemy aircraft. This immediately placed the division under even greater danger from enemy aircraft and anti-aircraft fire. The first patrol of five (*Continued on page* 40)

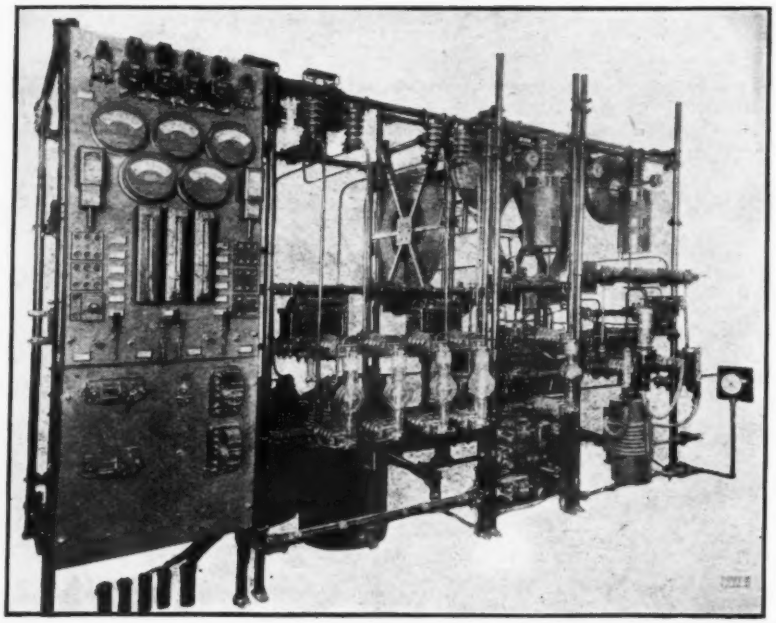

FOKKER D VII
62½"
7758 lb
21"
47¼"
9'2½"
Mercédès 160 H.P. Engine
High speed approx. 120 M.P.H.
Full cantilever wings
Color scheme
Vari-colored camouflage
Black crosses with white
outline. Fin and rudder white.
7'0"
6'4"
5'1"
23'8"
4'2"
29'5½"
23½"
22'11½"
Scale
¼" = 1'
Stockton Ferris, Jr.



Italy's world long distance record breaking plane, a Savoia-Marchetti S-64 (550 h.p. Fiat A22-T. engine) is seen above

Below is a striking view of the world's largest landplane, the Junkers G-48, built by Germany. Gauge its size by the man at left





Radio transmitters at WCC Chatham

Special Course in Aerial Radio

By Capt. L. S. Potter

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Storage Batteries

(*Chapter* 8)

EXTRACT from the radio communication laws of the United States:

"*That from after October 1st, 1912 it shall be unlawful for any steamer of the United States or of any foreign country navigating the ocean or the great lakes, and licensed to carry, or carrying, fifty or more persons including passengers and crew, to leave, or attempt to leave any port of the United States unless such steamer shall be equipped with an efficient apparatus for radio communication, in good working order, capable of transmitting messages over a distance of 100 miles day or night. An auxiliary power supply independent of the ship's main power plant must be provided, which will enable the sending set for at least four hours to send messages over a distance of at least 100 miles, day or night, and efficient communication between the operator in the radio room and the bridge shall be maintained at all times.*"

The above regulations remain in force today; and since storage batteries are sources of emergency current supply on ships, as well as being important features of every aerial radio apparatus, it will be seen that this is a sufficiently important part of radio to merit an article to itself, even if we disregarded the fact that 10% of the total marks in the commercial operators examination are allocated to a paper on storage batteries.

What Is a Storage Battery?

A storage battery is a device, consisting of one or more cells, in which electrical energy is stored for use on future occasions. These cells must not be confused with the dry cells referred to in a previous article. The latter are useless when exhausted and must be discarded. The cells of a storage battery may be recharged indefinitely, subject to certain limitations. When electrical energy is flowing from a battery, the latter is said to be discharging; when it is flowing into a battery it is said to be charging.

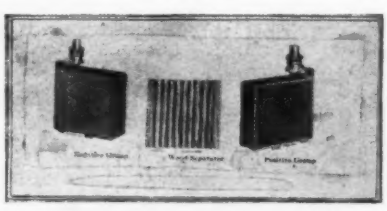


Plate groups

How does this energy flow to or from a battery? To understand this you must understand something of the construction of a battery. A battery cell is made up of two kinds of plates, negative and positive, which are divided by separators. Groups of each kind of plate are usually connected with an extension or alloy strap, as shown in Fig. 1.

Each group is dovetailed into the other with a separator between the positive and negative plates. The negative group generally contains one more plate than the positive group. The function of the separator, which is made generally of specially treated wood or rubber, is to act as an insulator. Were any of the negative or positive plates to touch, the result would be a short circuit inside the battery.

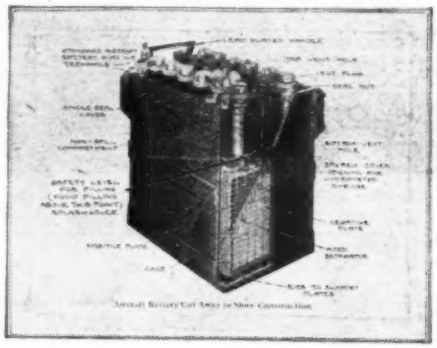
The plates are placed in a hard rubber container which is filled to a certain level with a mixture of sulphuric acid and water referred to as the electrolyte. The plates are made of a lead compound which, after being allowed to harden between supporting grids, is chemically treated and becomes the active material of the plates. A difference in the composition of the active material constitutes the difference between the negative and positive plates. In a fully charged battery, the active material of the positive plate is lead dioxide, more often called had peroxide, and that of the negative is metallic lead in a spongy form.

WHEN a battery is properly connected to an external circuit, the chemical action of the electrolyte combining with the active material of the plates causes a current to flow. As the current continues, some of the lead leaves the electrolyte and mingles with the active material of the plates; and this action reduces the strength of the electrolyte. It is this strength of the electrolyte, measured in terms of specific gravity, which forms the most important indication of the battery's condition.

The specific gravity is measured by an instrument called the Hydro-

meter. The makers generally give instructions with each battery as to the limit below which the specific gravity should not be allowed to drop. When this limit is reached, the battery must be charged. This is done by connecting it to a source of direct current, the positive pole of the charging source to the positive pole of the battery, and the negative pole of the charging source to negative pole of the battery.

WITH this current passing through them, the plates are forced to give up the sulphuric acid which mingled with them during the discharge. As the sulphuric acid returns to the solution, the specific gravity of the latter increases. When all the acid has been drawn out of the plates, the battery may be considered fully charged. This will be indicated when the specific gravity, as shown by the hydrometer, does not increase after the charge has been continued at least one hour.



Summarized briefly then, a storage battery consists of one or more cells, each of which is made up of a series of plates immersed in electrolyte. With a connection made between the two terminals, chemical action inside the cell causes a current to flow which decreases the specific gravity of the electrolyte. When this has been reduced to a certain limit, the cell must be charged by passing through it a direct current in the reverse direction to the outward flow, and this must be continued till the specific gravity of the solution has been revived to a normal reading.

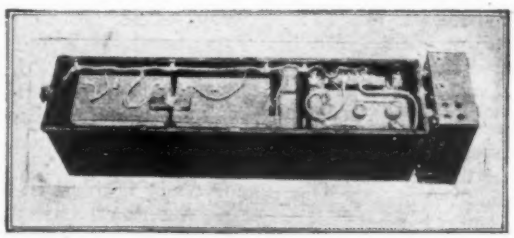
So much for the operation of a battery. Now for some points connected with its maintenance.

Maintenance of a Storage Battery

The following rules are given by the makers of the Exide battery, one of the leading batteries in use today. We cannot do better than quote the actual words of the manufacturers.

(a) Keep the outside of the battery clean and dry.
(b) Add approved water regularly.
(c) Avoid over-discharge as a constant practice.
(d) Charge properly.

In connection with (a), no radio operator with any interest in the instruments under his charge would ever allow his batteries to remain dirty or corrode, and the one follows the other. If dirt or damp is allowed to accumulate on a battery, it will permit the electric current to leak away, and in time the terminals will corrode.



Battery installation

To prevent corrosion all surfaces, bolts and joints should be scraped clean and smeared with pure vaseline. Ordinary grease will not do because this often contains animal or vegetable fat which, instead of resisting corrosion, aids it. If corrosion has started or any of the electrolyte has spilled, the surfaces after being scraped clean must be wiped with a weak solution of baking soda or ammonia and water, then rinsed with water, dried, and a coating of vaseline added.

Add approved water regularly. The importance of this instruction lies mainly in the second and fourth words. The water must be approved, and it must be added regularly. Water that has been distilled, not merely boiled, is approved for this purpose, and a supply of distilled water will always be kept available by the conscientious operator. It must be added regularly to keep the solution up to the level specified by the manufacturers. This is generally about half an inch above the level of the plates.

The thought may occur, will not the continual adding of water weaken the solution and reduce the specific gravity? The answer to this is "No!" Water may evaporate or escape as gas, but the acid in the solution can only be lost through spilling. If electrolyte is lost in this manner it must be replaced with a chemically-pure solution and not with water alone.

If a solution is not available it may be made by obtaining chemically pure sulphuric acid and mixing it with an appropriate quantity of distilled water. The proportions may be ascertained by reference to a chart which will be supplied by the makers on request. It should be borne in mind that acid of this strength is extremely dangerous, and the greatest care should be taken in handling it.

Metal containers should not be used for mixing. Glass, china or earthenware are the best. Pour the acid into the water, not the water into the acid as this might cause sputtering, and consequent personal injury. Stir with a wooden spoon and allow the mixture to cool before pouring it into the battery.

SINCE batteries used in aerial radio are likely to be subjected to far more rigorous treatment in the air than those used at a ground station, a battery has been designed for air use which is non-spillable at whatever angle it may be placed.

The principle involved is something similar to that of the safety ink-well, which was non-spillable provided it was not filled over a certain level. In this battery, a hollow tube several inches long passes from the vent plug to just above the plates. Provided electrolyte is not added to a level higher than that permitted by the makers, the bottoms of these vent tubes will always project above the level of the solution no matter in what position the battery may be placed.

With this type of battery in particular it is essential to watch the level of the solution. Overfilling may easily cause danger to the plane.

Concerning (c), although the makers recommend that a battery shall not be used without recharging after its specific gravity has dropped below a certain level, in cases of emergency no real harm will be caused if a battery is discharged to its limit, provided it is promptly recharged. Constant over-discharging will, however, render the battery increasingly difficult to recharge.

Charging Batteries

The best method of charging batteries will depend on the number of cells, the time available and the type of charging apparatus. Ground stations will generally be provided with battery charging facilities, while the aerial radio operator

will generally have similar facilities at his home station.

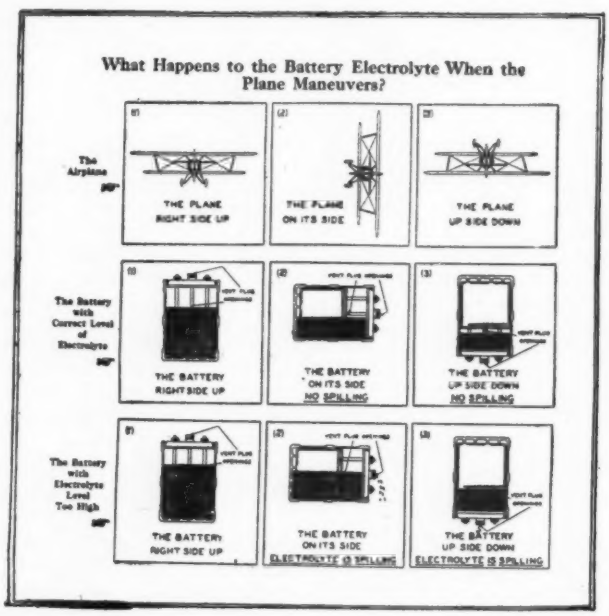
Only direct current may be used for charging, and in cases where only alternating current is available, an instrument known as a rectifier must be included in the charging circuit. This, as its title suggests, rectifies the oscillations of an alternating current, turning it into a one way current. Rectifiers fall into three main classifications; chemical cell, tube and vibrator. The principles of the vacuum tube in passing an alternating current in one direction only, have already been explained in an earlier article.

ONE of the best known tube rectifiers is made by the General Electric Company and is known as the Tungar rectifier. Among the chemical rectifiers, one made by the Exide Company is perhaps the most popular. This charges directly from a 110 volt to a 115 volt alternating current.

The rate of charging depends on the condition of the battery. If it is considerably run down, the initial charging may be at a higher rate but this must be reduced as the charge nears completion. The finishing rate of charge for any type of cell may be obtained from a chart issued by the makers, and provided sufficient time is available, it is better to charge at this rate, or less, for the whole period.

To do this would take probably from eight to fourteen hours, and if this time is not available, the initial rate of charging must be increased, and then reduced to the finishing rate as soon as the cell starts gassing.

Gassing results from the following causes. The effect of a charging current passing through a battery is to drive back to the electrolyte the acid that has escaped therefrom and attached itself to the plates. At the beginning of the charge, since there will be large accumulations of acid to be driven back to the solution, the whole of the high rate of current will be utilized.


What Happens to the Battery Electrolyte When the Plane Maneuvers?
The Airplane
THE PLANE RIGHT SIDE UP
THE PLANE ON ITS SIDE
THE PLANE UP SIDE DOWN
The Battery with Correct Level of Electrolyte
THE BATTERY RIGHT SIDE UP
THE BATTERY ON ITS SIDE NO SPILLING
THE BATTERY UP SIDE DOWN NO SPILLING
The Battery with Electrolyte Level Too High
THE BATTERY RIGHT SIDE UP
THE BATTERY ON ITS SIDE ELECTROLYTE IS SPILLING
THE BATTERY UP SIDE DOWN ELECTROLYTE IS SPILLING

AS THE process continues, however, there will be less acid remaining on the plates, and this will only engage a portion of the current passing through the battery. The remainder commences to decompose the water in the solution into oxygen and hydrogen which escapes through the vent holes and gives the electrolyte the appearance of boiling.

Any excessive gassing has a detrimental effect on the plates and should be avoided. The battery compartment should be ventilated in order to dispose of accumulations of gas, and vent plugs should be kept screwed down and never removed except to take readings or add water. As a further precaution, you should never bring any naked lights, lighted pipes or cigars near a battery that is charging or shortly after. The gas which forms is highly inflammable.

Method of Charging

Most up-to-date stations will have an efficient charging panel on the lines of the one shown in Fig. 6, which will be designed to charge the battery used, at its appropriate ampere rate. The panel shown in the illustration is designed to charge a 12 volt battery at a 10 ampere rate. The principal feature of whatever charging method is used is the type of resistance employed. On the ordinary lamp bank charging panel, tungsten lamps such as Mazda lamps supply the resistance which must be inserted in series in order to obtain the desired amperage. It is a simple matter to prepare a lamp charging panel. Figure 7 illustrates a typical circuit.

To decide the size and number of lamps to be used, it is necessary to know the voltage of the charging circuit, the number of cells to be charged, and their charging rate. If cells with different rates are being put on together, the charge rate of the lowest should be taken.

For example, the charging current has a voltage of 100, and we are charging 18 cells at a time. Referring to the manufacturers' table showing the watts necessary to give one ampere with a 115 volt Tungsten lamp, we find that 175 watts are needed. This means that to charge eighteen cells in series with a 100 volt direct current, we shall need a 175 watt 115 volt tungsten lamp to give us a 1 ampere charging rate.

HOWEVER, the manufacturer's charging rate for these cells is 6 amperes, so we must multiply the wattage by 6. 6 x 175=1050. So in order to obtain a 6 ampere charging rate we must use a 115 volt lamp of 1050 watts, or alternatively, a sufficient number of lamps of the same voltage in parallel to bring up the required wattage. In this case four lamps of 250 watts and one of 50 watts would answer the purpose. So long as the total wattage is approximately the same, the correct resistance is being given.

During the process of charging, readings should be taken at regular intervals with a hydrometer, and the level of the electrolyte inspected to see that it is being maintained. Any losses through evaporation must be made up. Do not forget that the positive terminal of the battery must be connected to the positive of the charging circuit. If there is any doubt as to which lead is positive and which is negative, this may be ascertained either by including a small ammeter in the charging circuit, by a direct current voltmeter, or by dipping the ends of the two leads into a glass containing a weak solution of salt and water.

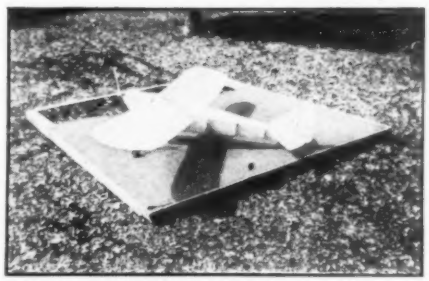
If the ammeter reads both ways with zero in the centre, the direction of the hand will at once show the direction of the current. By connecting the positive terminal of a voltmeter with the positive wire of the charging circuit, and the negative terminal of the voltmeter with the negative wire, the hand on the meter will point in a proper direction; but should the wires be incorrectly connected, the hand will spring backwards.

If a doubt exists and no meter is available, take two wires from opposite sides of the (*Continued on page* 44)

How to Build

The Buhl Bullpup

By
Prof. T. N. de Bobrovsky



Two views of the finished model

A Flying Model of this Popular American Light-Plane

THE Buhl Bullpup is one of the most popular types of sport planes in the United States today. It is a simple design of the conventional type and low-priced. This plane is not radical in design, being similar to the monoplanes that were in use in Europe before the war. The fuselage lines are the same as the old Robert Esnault Pelterie French monoplane (1910); the landing gears are the same as the 1912 type of the same plane; the wing is designed along the lines of the old Bleriot XI; and the tail group is also taken from an old design.

I believe that it is this resemblance to the old-time favorites that has made the Bullpup so popular. The forerunners of these planes gave good performance and the models did the same in contests. This is the reason why I think readers will gain a great deal of pleasure both in building and flying the model of the Bullpup.

The drawings are in full-sized scale, having used all measurements that could possibly be obtained and making small modifications that were necessary.

The first model was built in our laboratory (A.R.L.) by Frank Gellauro, a high school student, and gave a highly satisfactory flying performance. This model does not need very much material and is not heavy. When painted in the original colors, black and white, it is good-looking and attractive.

The airfoil section used is the same as in the original airplane, the characteristics of which are excellent. Using only half the total number of motor revolutions, the model will take off in four feet, fly with remarkable stability and make a perfect landing.

Successful take-offs were made in cross winds, and in head or tail winds also. This model can be used for flying indoors, but is really an outdoor model, as are all my models which have been published in this magazine.

For reference, when starting to build this model, there are two pictures of the finished model, and, in Drawing 1, there are three different views. By careful study of drawings 2 and 5 it can be seen that the model has no motor stick and that the fuselage supports the rubber motor directly. It also is seen that the fuselage has four longerons and seven bulkheads.

Begin by making the seven bulkheads, which are shown in drawings 4 and 5. Number 1, which is made of 1/4" hard balsa, is the nose piece and holds eyelets for the propeller shaft. Numbers II and III are made of 1/8" hard balsa. The other bulkheads are made of 1/16" medium balsa sheets.

Your attention is called to bulkhead No. IV, which holds the rear hook. To fasten this, glue a piece of balsa strip (8) to the bulkhead. The four longerons are made of 1/16" sq. hard balsa strips.

Drawings 2 and 3 show side and top views for assembling the fuselage. Use 1/16" medium balsa strips to brace the fuselage, as shown in the drawings. Make the bracing exactly the same as those shown.

Then with 1/64" balsa sheet cover the top of the fuselage. Cut out the space between bulkheads III and IV for the cockpit (see Fig. 2) and cover with cellophane. In the real airplane the cockpit is open, but a covered cockpit is best in a model as an open one creates bad drag and effects the stability.

To finish this work carve a 10" diameter propeller. Place this with the shaft and washer in the usual manner. Between the propeller shaft and rear hooks place six strands of 1/8" flat rubber.

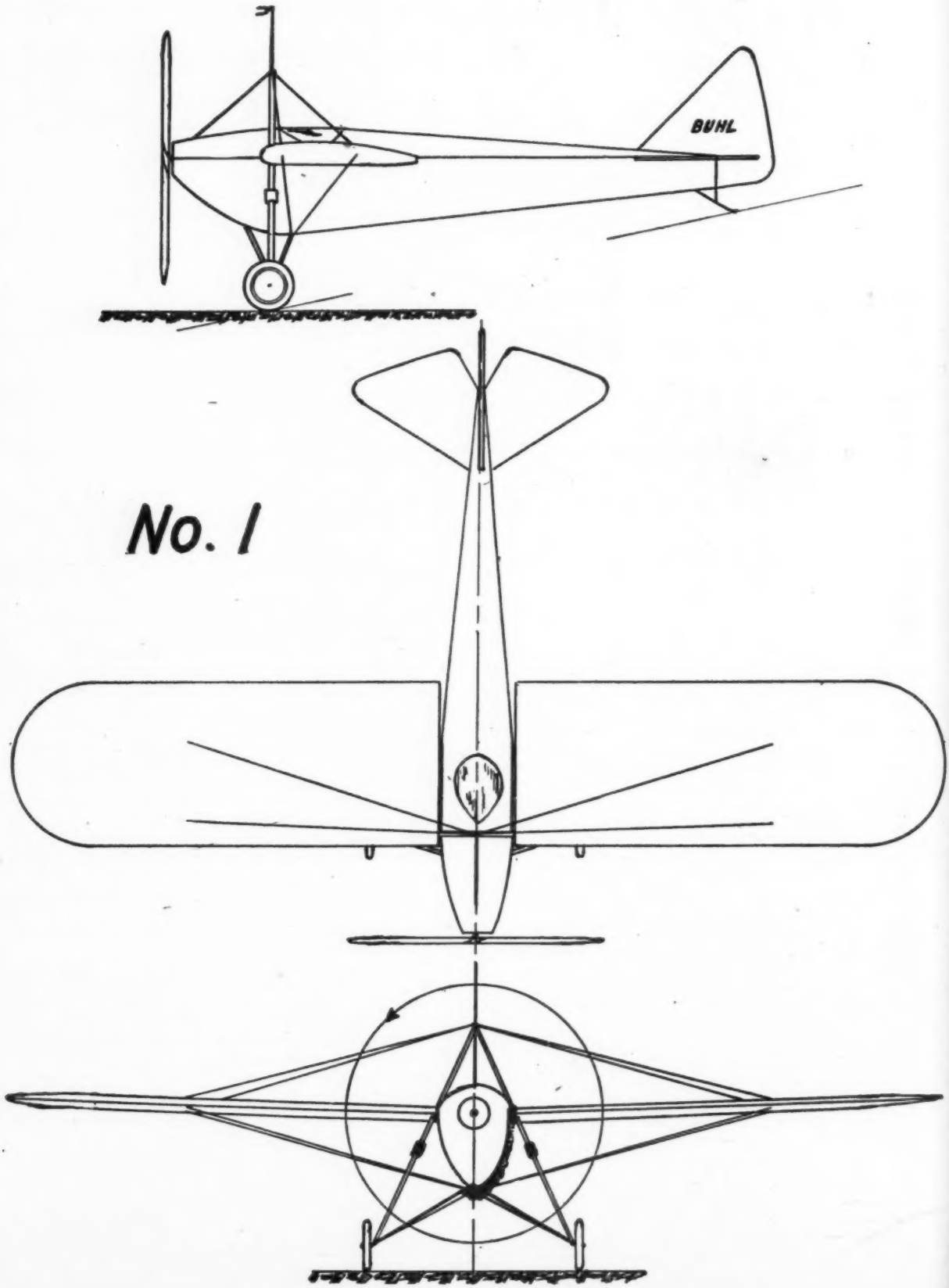
Your fuselage is now ready to be covered with Japanese tissue. This type of fuselage requires a little more time and work for covering than the usual square fuselage, but patience and strict attention to small details will certainly give good results. When finished give one coat of natural dope.

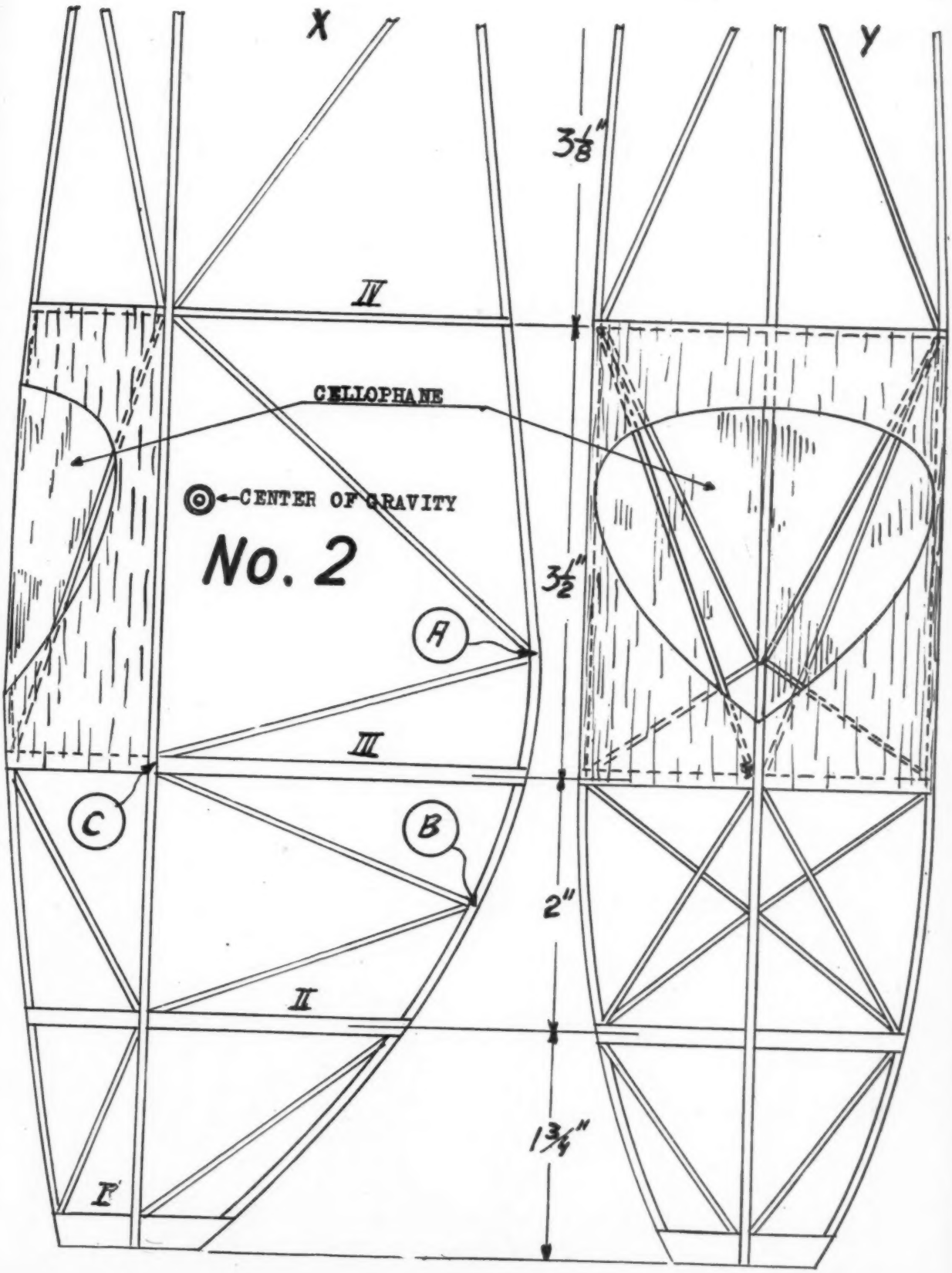
The next step will be the landing gear, shown in drawing 6. Two pieces of 1/8" round hard wood (1) are glued together, and ambroided to the fuselage, where it is marked "C." The dummy shock absorbers are made of soft balsa (2). In the same drawing numbers (3) and (4) are struts, made of 1/8" x 1/16" hard balsa strips. Make two of each. These are fastened to the fuselage at "A" and "B" and the ends of the struts (1).

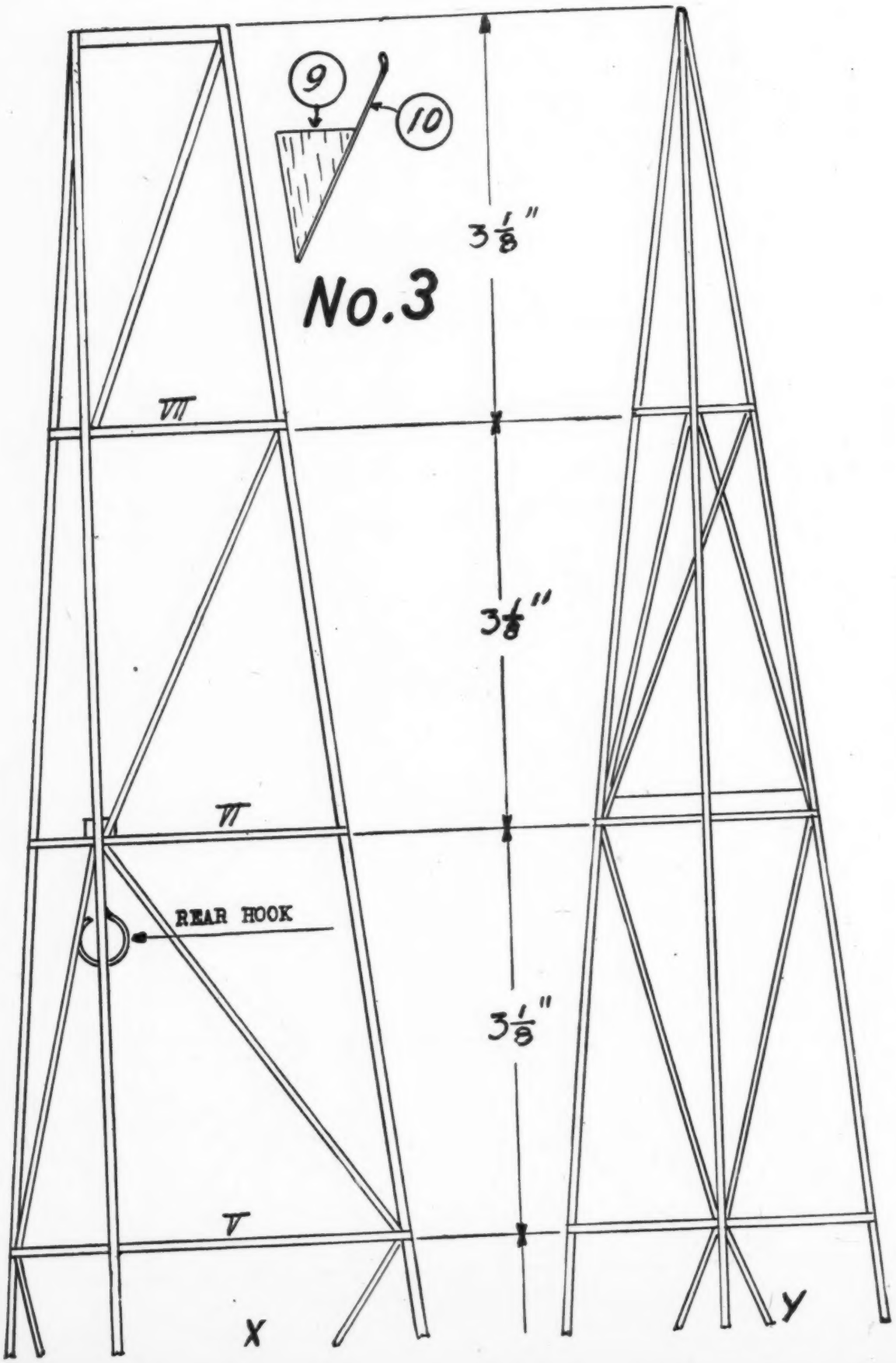
We used air wheels in our model, which can be seen in the picture, but normally two 2" celluloid wheels should be used. Use black wheels and black dope or India ink for coloring the landing gear. The landing gear struts No. 1, are joined together above the fuselage to hold the wires of the wings. This cabane is made rigid by using a bamboo strut (6).

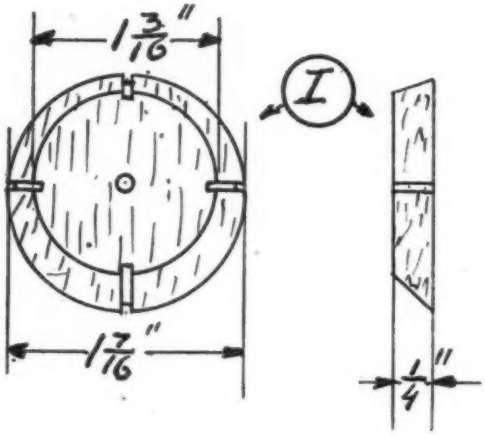
ABOVE this is glued strut (6), which serves as the holder for the Pitot tubes (7), made of bamboo. In the *Bullpup* the Pitot tubes are not placed in the wing, as is usual, but in the cabane. The reason for this is that the tubazione is much shorter than when applied to the wing and is a more simple method for mounting the wings.

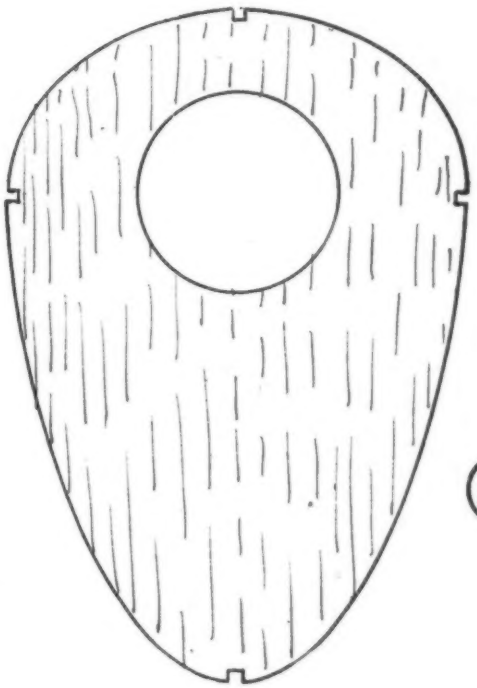
The tailskid is a 1/16" piece of balsa sheet triangle (9) and a bamboo skid (10.) See drawing 3. Glue these to the end of the fuselage as shown (*Continued on page* 30).

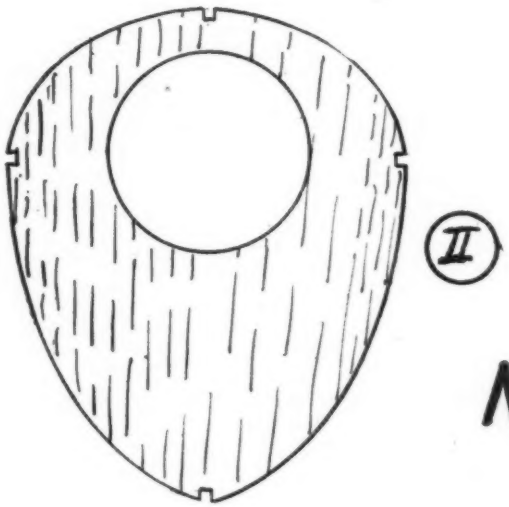

BUHL
No. 1


X
Y
3 1/8"
IV
CELLOPHANE
CENTER OF GRAVITY
No. 2
3 1/2"
A
III
C
B
2"
II
1 3/4"
I

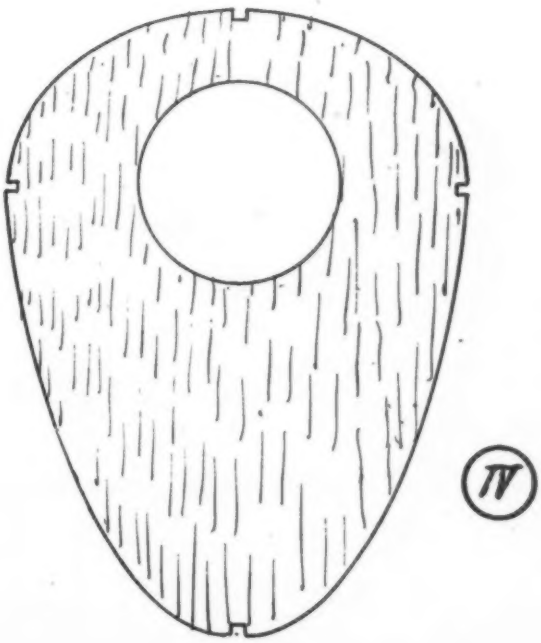

9
10
No.3
3 1/8"
VIII
3 1/8"
VII
REAR HOOK
3 1/8"
V
X
Y

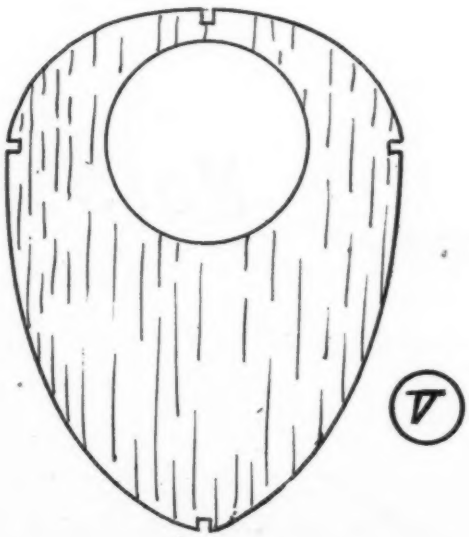


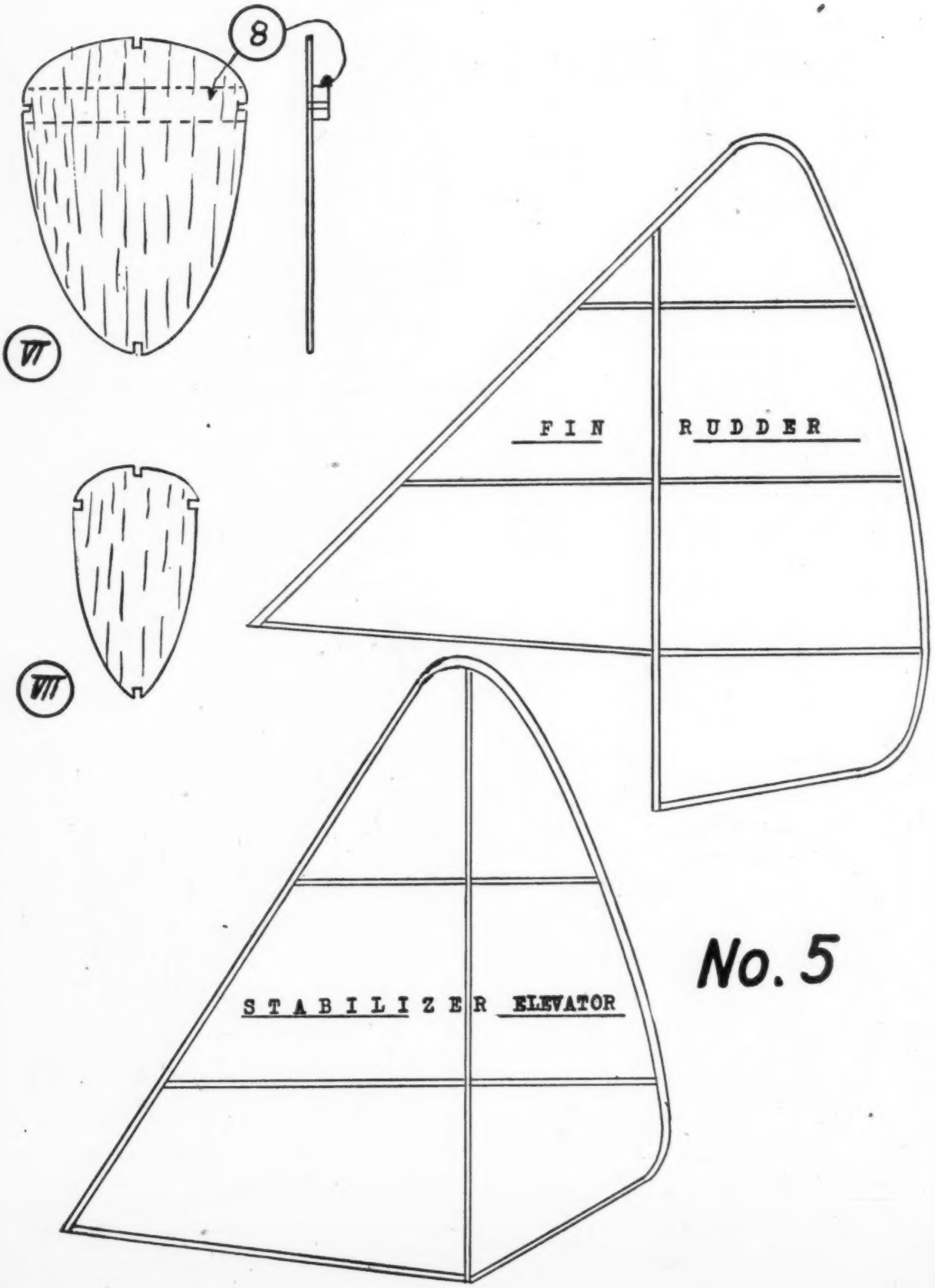


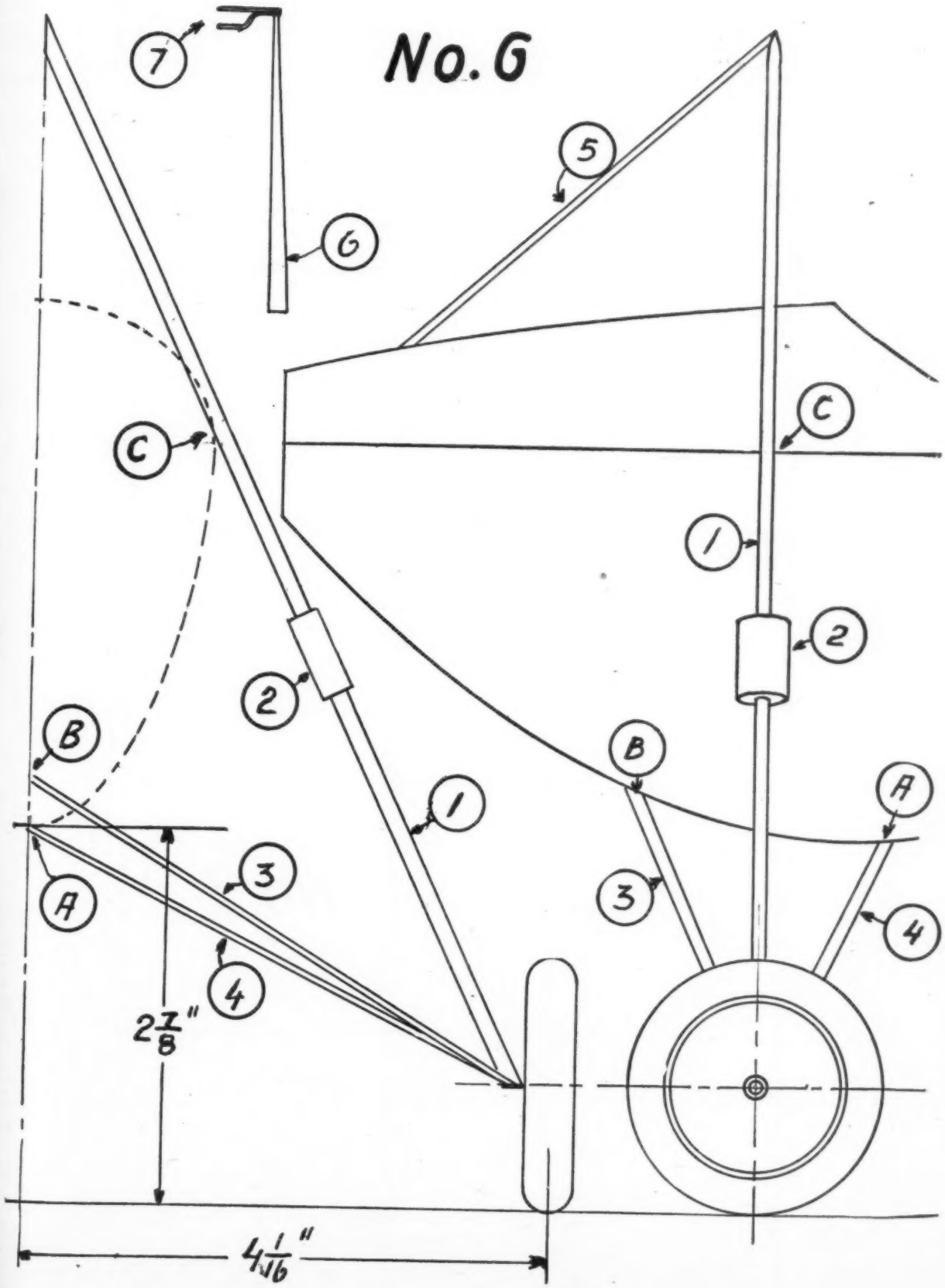


No. 4






8
VI
VII
FIN
RUDDER
STABILIZER
ELEVATOR
No. 5

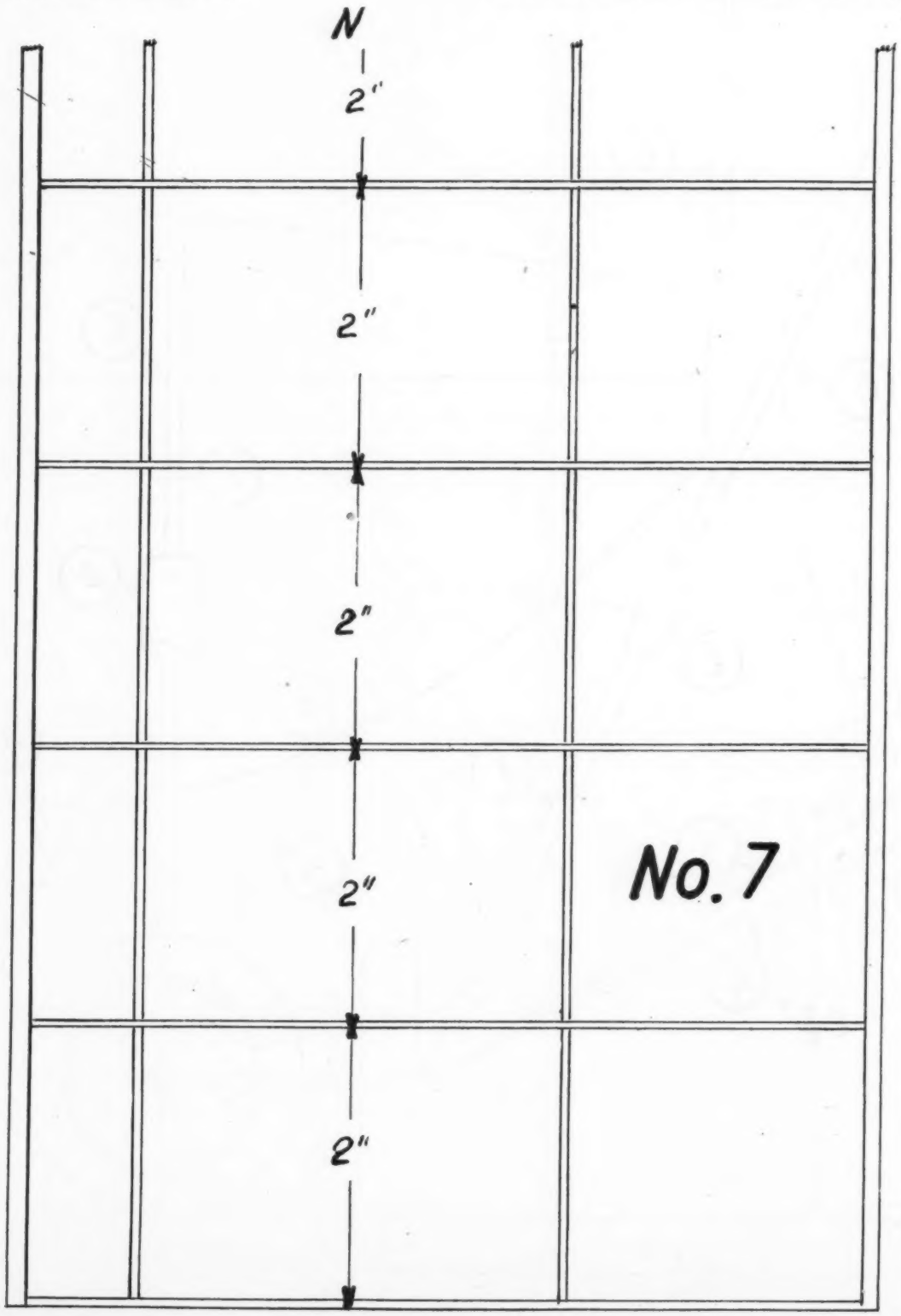

No. G
7
6
5
C
C
1
2
2
B
B
A
A
1
3
3
4
4
2 7/8"
4 1/16"

in drawing 1. Your model is now ready for taxi-ing with its own power.

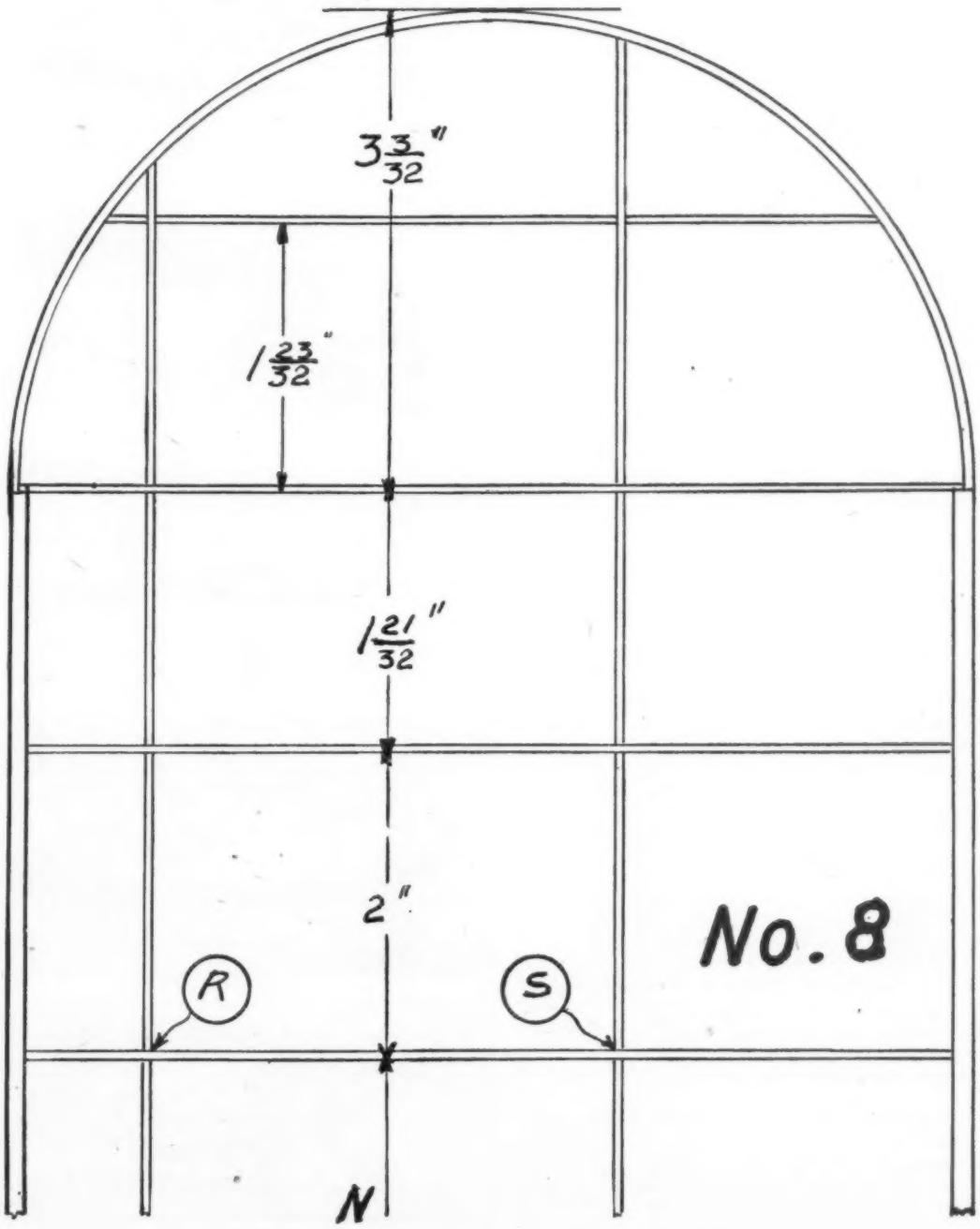
Now make the vertical surface (Fig. 5) frame and two horizontal frames by using 1/16" square hard and soft balsa strips. Cover these on both sides with Japanese tissue, and apply a coat of natural dope.

In drawing 6 you will find the word "*Buhl*" written twice. Cut these out and glue them to the fin, as shown in the drawing. Then glue the three surfaces to the fuselage.

If you follow instructions carefully, you cannot make a mistake in this work. Now (*Continued on page* 40)



BUHL BUHL



"Scrambled Picture" Contest

Here They Are Unscrambled For You— But Read On . . .

HERE'S the news you've been waiting for in connection with our monster *Scrambled Picture* contest—Next month it is hoped to publish in MODEL AIRPLANE NEWS the winners of this great contest!

And don't think that it has been or is an easy job to choose winners from nearly 2,000 contestants whose solutions to the contest were virtually all neck-and-neck insofar as identification of the planes was concerned.

One of the greatest surprises of the contest was the fact that so many competitors knew so much about airplanes as to be able to identify them from a pasted-together scrambled picture.

The judges have had one "Phew" of a time—if you know what we mean.

First it was a matter of choosing all solutions that bore correct identifications of the planes themselves. Nearly 1,500 of the 2,000 competitors had done this correctly.

Then came the job of wheedling out those who had fallen down on identifying the type of engine with which each plane was equipped. Then it became a matter of combining the two, and sorting those that had not only plane and engine identified correctly, but also "better and clearer" identifications.

For instance, one competitor might have had "Picture No. 1—Curtiss *Hawk*, Conqueror engine." Now, obviously if the next competitor had identified the plane as a "Curtiss *Hawk* P6, 600-horse-power Curtiss Conqueror engine," then this identification was better than the first. Then—somebody would come along with "Picture No. 1, Curtiss *Hawk* (Army) P6 Prestone-cooled 600 horse-power Curtiss Conqueror engine."

Of course, that was all right for Picture No. 1.

Then perhaps the winner on Picture Number 1 would be all wet on Picture No. 2; that is he would identify the plane and engine correctly, but as in the case above would lose out on the "better and clearer identification" as outlined in the foregoing paragraph.

So you can just imagine the "good time that was had by all."

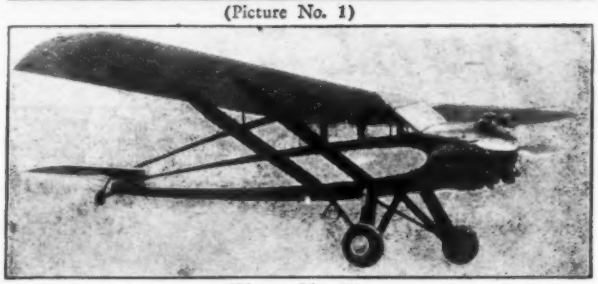
Now perhaps you'd like to know what all the scrambled pictures were?

Well, here goes:

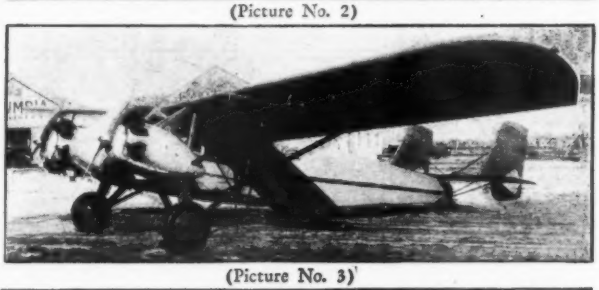
Picture No. 1 depicted a F8C7 Curtiss *Command Helldiver*, equipped with a 575 horse-power Wright Cyclone engine.

(*Continued on page* 44)

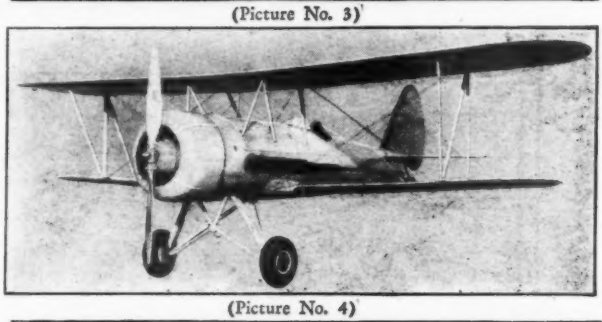
(Picture No. 1)



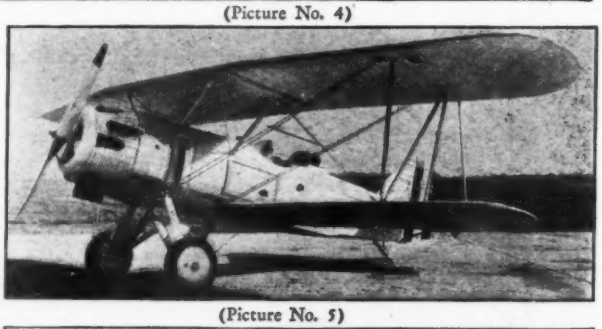
(Picture No. 2)



(Picture No. 3)



(Picture No. 4)



(Picture No. 5)

(Picture No. 6)

STERN'S SKY CADETS CONTEST WINNERS

Success with a capitol S marked the first annual invitation tournament at Van Courtlandt Park recently. First prizes went to (back row, left to right) Jerome Kittell, twin-pusher event, 2 min., 37 sec.; Dante Algeri, glider event, 38 sec.; Alton Du Flon, high point scorer; Frank Zaic, speed event, 62 m.p.h.; Henry Drshinsky, commercial event, 2 min., 27 sec.
Front row, Mr. Samuel Mundheim, president of Stern Bros., Ben Shereshaw, supervisor of Stern's Sky Cadets, and Capt. H. J. Loftus-Price, editor of Model Airplane News

The American Sky Cadets

Full Report of the Brockton Fair Model Airplane Contest

THE recent fair at Brockton, Mass., brought together model airplane enthusiasts from all parts of New England. Early in the morning they came, bringing scarlet-winged monoplanes, purple-bodied biplanes, planes with rakish lines that suggested speed, and owners with expressions of optimism that lasted, unfortunately, in many cases but a short while. It was a great array, and if anyone tells you that America is not air-minded, mention the one hundred and five sturdy little flying models that took part in the Brockton Fair. They were all sorts, shapes and sizes. Hydroplanes, compressed-air models, auto-gyros and even a rocket-plane!

If only the wind had been reasonable! ! Why do not all the model airplane builders in the country get together and fix up a real good weather man, somebody who can deliver the goods? When one thinks of all the torn-off undercarriages, the crumpled wings, the broken propellers, to say nothing of the crushed hopes and hours of work, it would be worth while.

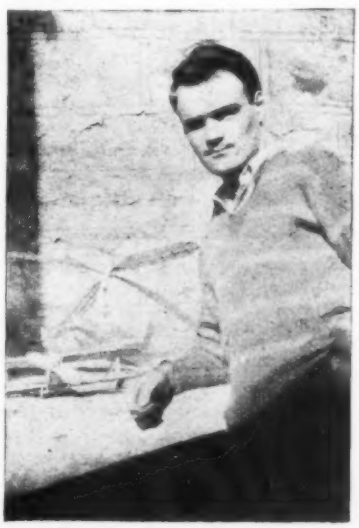
At Brockton, the contestants had to contend with a wind of about velocity 5, a little over twenty miles per hour, and this was not the worst. Had it been a steady 20 m.p.h., things would not have been so bad, but it kept coming in gusts that averaged considerably more. A tough business for small planes weighing only a few ounces, but it didn't daunt the boys in Brockton. It made it necessary, however, to have all the planes hand-launched to give them the chance of gaining altitude before the wind took over complete control.

The following contests were scheduled:

1. Junior Hydroplanes (boys 15 and under).
2. Junior Fuselage Models (boys 15 and under).
3. Junior Hand launched (boys 15 and under).
4. Senior Hydroplanes (boys 16 and over).
5. Senior Fuselage Models (boys 16 and over).
6. Senior Hand launched (boys 16 and over).
7. Senior Stunt Models (boys 16 and over).
8. Senior Scale Models (boys 16 and over).
9. Planes powered with other than rubber. (All ages.)
10. Junior Stunt Models (boys under 15).
11. Junior Scale Models (boys under 15).
12. Open contest between Brockton and outside towns.

A word here about the stunt flying. So far as the judges were concerned, this did not seem to be limited to any particular contest. Caught in the different eddies, some of the planes performed stunts and evolutions that made Ernst Udet's performance at Cleveland recently look mild by comparison.

There was one fuselage model that



Bob G. Kilgour Bronx, N. Y., with his Autogyro model

dashed at the judges as though determined to get a decision one way or the other at all costs. As one judge ducked, it turned abruptly at right angles and attacked another. Having reduced him to a prone position it swerved again and made for the third.

A weak voice from the time-keeper a few seconds later made the judges look up cautiously. The plane was settling quietly to a three point landing a few yards away. You could almost see the smile of satisfaction on the fuselage. I still hold very deep suspicions of that plane.

From the judges' point of view too, the wind had much to answer for, as they had to rush from one corner of the field to the other to keep in sight planes that had disappeared behind clumps of trees. Sometimes the plane would appear again a few seconds later flying in a completely opposite direction, and sometimes a distant shout told of a crash. However, it was good fun. If only some of the planes had done as well on their actual tests as they did on their trial flights, several of the awards would have gone to different owners.

As it was, the results, considered purely as such, were not outstanding, but taking into consideration the weather and the tremendous amount of repair work put in by the owners, they certainly were outstanding.

THE duration record went to Albert Malouin whose fuselage model remained aloft for 1 minute 23 seconds. Other fuselage models owned by John Bartoll and Chester Wollowicz were still flying when they disappeared from sight after 52 and 45 seconds respectively. Donald Brunton had bad luck in the same contest. His plane looked like a sure winner until it hit the trees after 49 seconds. Too bad, Donald.

The tanks that were provided last year for the float models were no longer available so that it was really difficult to judge their all-round performance, and they had to be hand-launched in the same manner as the rest. Still, faint heart wins nothing, least of all in model airplane contests, and the hydroplane owners were willing to demonstrate their models with or without water.

When the time came for the stunt flying contest the wind had increased and was probably nearer thirty than twenty miles per hour. This, and the fact that the gusts were stronger, may have had more to do with the stunts performed by the planes than did the peculiarities of their designs.

CONTESTANTS AT THE BROCKTON FAIR

At top, left to right, Wain Johnson and Roy Washburn, holding scale models of a Sikorsky Amphibian and an Autogyro, respectively. Bottom, Stanley Usis with his compressed air-model ***—Daily Record***

They rolled and they spun, they nose-dived and they barrel-looped, they stalled and they flew upside down. One or two of them landed in this position, but were ruled out by the judges who held that these were stunts no self-respecting pilot would intentionally perform—even in his first fifty hours solo.

Eventually the decisions went to Peter Mollis and Everett Haydon for the Junior and Senior contests respectively.

A word here for the boy who built a smoke-screen model. His ingenuity was commendable, but either the smoke apparatus did not give the plane a fair chance, or the plane did not give the smoke screen an opportunity to work. Wherever it was the fault lay, the joint result was not as successful as was hoped.

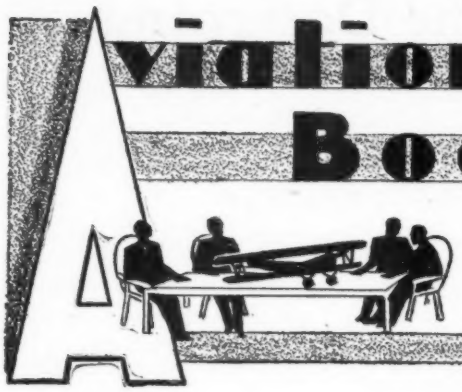
WITH the opening of the class for planes powered with other than rubber, the field was limited to two planes powered with compressed-air motors and the rocket plane. The first two were the largest models to be flown and looked as though, under better weather conditions, each was capable of creating new records. Unfortunately, gusts caught each, one after the other, just after it had been launched.

For the rocket plane a table was a necessary adjunct to the launching process. Hundreds of boys crowded round closely so that it seemed doubtful whether the plane would ever have enough room to take off. Eventually a space was cleared, but it was unnecessary. The method of propulsion functioned perfectly. The plane had flying speed from the moment the rocket commenced to splutter, but it rose straight in the air, did a perfect loop, and crashed on the ground behind the table.

A second attempt produced the same result. One wonders whether the propelling power was not too low under the fuselage so that the tendency was to force the plane upward rather than forward. The rocket was secured in the middle of the axle of the landing gear. Whatever the results, however, one cannot but admire the ingenuity of boys who experiment along lines as novel as this.

There are many lessons that may be learned from model airplane contests, both by the promoters and the participants. First of all a tolerably (*Continued on page 43*)

Aviation Advisory Board



Conducted by
Capt. H. J. Loftus-Price
EX-ROYAL AIR FORCE
CHAIRMAN OF THE BOARD

WHILE not adapted to combat purposes, the autogiro has attracted a great deal of attention in this country recently, and it promises to have a great future commercially and for private use. It is the invention of Juan de la Cierva, who has been working on its development since 1920. It became a practical flying machine at the time when the articulated rotor was first applied to it, and the American contribution of a starting gear, so that the rotation of the rotor can be started by the engine of the machine has removed the most serious objection that applied to its widespread use.

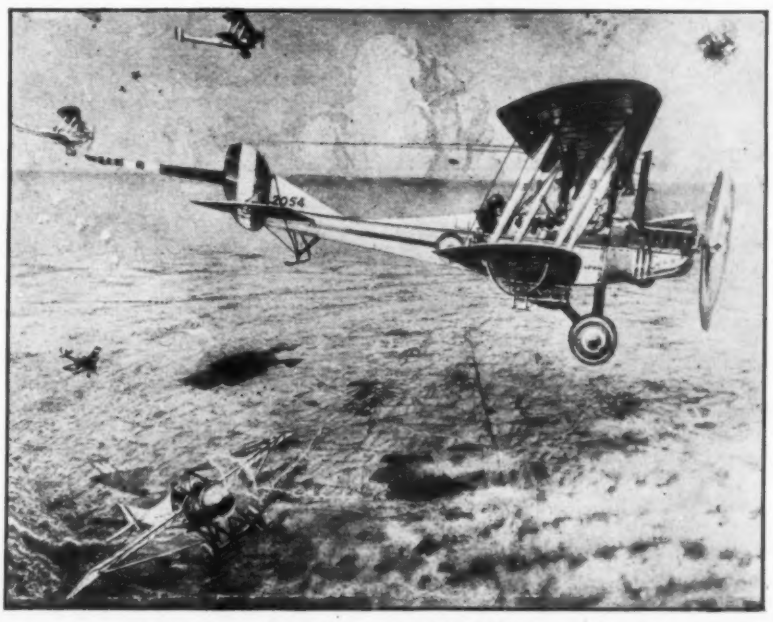
As is well known, the rotor is not driven by the engine except when the starter is being used, rotation being automatically maintained so long as the rotor is supporting the weight of the machine. The rotor blades are not fixed to the hub, but are articulated so that they are free to fold up like an umbrella. When in flight they assume at all times an angle which is the resultant between the centrifugal and lift forces. It is therefore impossible for the blade to transmit a sudden increase of lift without flapping upward, or to decrease its lift suddenly without flapping downward.

Thus the difference in lift between the blade which is advancing into the relative wind and that which is traveling rearward, is precisely compensated by the resultant flapping which takes place. It is equally impossible to transmit sudden high accelerations to the body of the machine through the rotor, the automatic increase in coning angle under increased lift acting as a shock absorber.

For the avoidance of gyroscopic effect the blades are articulated so that they are free to move back and forth a limited amount in the plate of rotation. The limitation of this movement is effected by cables which connect the four blades, and which are attached to the blades by common hydraulic shock absorbers such as are used on automobiles.

The autogiro is capable of almost vertical descent, but not of vertical ascent. It is capable of taking off in a very small distance, however, and of climbing at a very low forward speed along a much steeper path than the usual airplane. It is also capable of turns of very short radius; in fact it can be practically stopped in midair, turned through any desired angle almost on the spot, and started again in the new direction. It cannot spin or stall, and is inherently stable under all conditions of flight. The performance is considerably less than that of an airplane of comparable weight and power.

The Northrup "Beta": A smaller companion to the well-know "Alpha," this airplane is one of the most advanced in design of the recent productions. It is a low-wing cantilever monoplane of all-metal construction covered with smooth Alclad. It has two open cockpits, and a streamlined landing gear. With the Menasco air-cooled inverted 6-cylinder engine of 165 h.p., it is reported to have a speed range of 48-175 miles per hour.



A British wartime *BE 2e*, and Bristol *Bullet* monoplane

Foreign Developments

FRANCE: Probably the most interesting aircraft that have been produced recently in France have been the series of machines built to attack the records for duration and distance. They are all monoplanes powered with the Hispano - Suiza engines, and they represent the highest mark of weight - carrying ability combined with performance that has yet been

(*Cont. on p.* 46)

A Course in Airplane Designing

By Mastering This Valuable Course, the Model Builder of Today Lays the Cornerstone for His Career as the Aeronautical Engineer and Designer of Tomorrow

By Ken Sinclair

Engineering Methods

Article 26.

COOPERATION between engineer and production staff, then, is the end to be sought. How about the other departments? A salesman, selling a certain kind of ship, is bound to come in contact with many people who are interested in that ship. Many of these prospects have their pet likings, opinions, and objections to this and that about the ship. If the sales department is in close cooperation with the engineering staff the designers can consider this popular opinion and make changes in the ship that will result in a wider sale. The engineer who shuts himself up with a drafting board and a slide rule all day will never bring about this necessary cooperation, neither will he hold his job long.

Now for the buying department. Suppose an engineer contemplated a change in the design of the ship. He is changing some steel tubing structure to a duralumin channel arrangement. However, he is not in close contact with the buyers who get the raw materials. These buyers find a chance to stock up on good steel tubing of the size used in the particular part the engineer is changing. They grab the chance and buy up several thousand dollars' worth, pay freight and storage, and go to the engineer in high glee because they have made an excellent bargain.

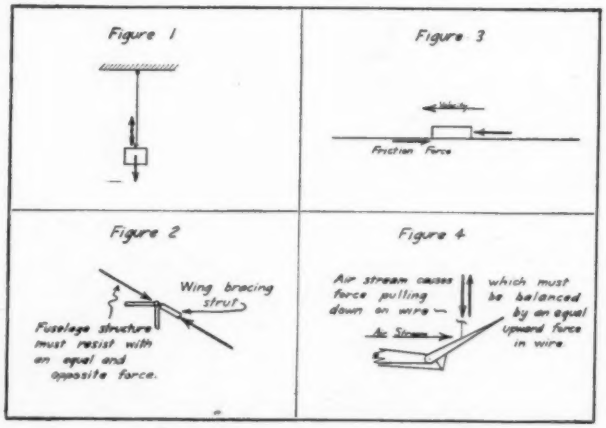


Figure 1
Figure 3
Friction Force
Figure 2
Wing bracing strut
Fuselage structure must resist with an equal and opposite force.
Figure 4
Air stream causes force pulling down on wire
which must be balanced by an equal upward force in wire
Air Stream

"Oh," he says, "why that's too bad. I've just specified a change to duralumin channel in that part. It's lighter. The blueprints have already gone through and the jigs have been made."

Several thousand dollars wasted. A week's profits written off. Probably, the engineer is released.

We see, then, that the engineer can do a lot more than splatter ink and wear out slide-rules. He can insure his job and his future by building up his concern. He can do this last through production methods, efficiency, and friendly cooperation. It's worth a lot of study.

So far in this *Course in Airplane Designing* we have covered the field pretty well. By this time the reader has a sound basic knowledge of airplane construction, theory, design and production.

Now with this article we will go into a more specialized field, engineering methods. We have learned what the engineer does, now we will learn just how he does it and with what tools. By the time you have finished this course you will be able to figure strut loadings and sizes and angles. Better still, these engineering methods apply equally to all other types of designing—bridges, buildings, automobiles, etc.;—and you will find them of great use in everyday work.

They will explain a great many mysteries and add to your understanding of what makes the wheels go round in our modern world. They will enable you to design planes accurately and scientifically; they will give you the knowledge that will some day help land you a good job in a big aircraft plant or some other engineering organization. Need we say that these next articles will be too valuable to miss?

Furthermore, I'll guarantee that there will be no complex mathematics to stump you, if you can add and subtract and multiply and divide.

The young man who has wisely decided to become an aeronautical engineer is faced, when he comes to the task of preparing himself for his future profession, with a twofold task. First, he must know what an airplane designer does—what qualities he designs into his ships, what characteristics a ship must have for some particular use, what he can do to insure himself a good job in the future—and, second, he must become familiar with the tools of the engineer.

IN THIS course, so far, we have tried to gain a rather general, yet practical, knowledge of airplane designing and production. Now we are going into the second part of the task; the job of getting our tools—we call them tools, but really they are principles and methods, rather than calipers and hammers—and we must get those tools "sharpened up" in our minds for action.

All engineering work depends on a few simple principles. There is nothing difficult about learning to use them; it is only a matter of a little close study and careful practice. The principles are much the same for the design of a bridge or a locomotive as they are for an airplane. For this reason, when you study the following articles in this course, miss nothing. They will come in (*Continued on page 41*)

How to Build

A Super-Light Wing

By Major H. W. Landis

Box Spar Construction

WHEN one reads so often about the large planes being constructed with box spar wings, it makes one wish for a design of a model wing making use of a single box spar and full cantilever construction as well.

The wing spars are the main pieces to which the wing ribs are secured, and they form the backbone of the wing structure. Were one of those to break from too much strain the wing would collapse.

These spars, or beams as they are sometimes called, are the heaviest structure in the whole airplane assembly. They support more than the entire weight of the airplane and everything aboard the craft because of various forces which are working on them due to the airflow over and against the wings.

In order that the plane should look well and give good performance in speed and climbing ability, the whole must be made very light but at the same time very strong.

Some wings are designed with more than two spars in them, but the two-spar wing is the one used in the majority of cases.

Box spars are used in wings of double spar design, and when designed properly also have been found to be well suited to wings having but a single spar.

The box spar construction is exceptionally strong and light and this type wing spar can easily be used in model wings with an increase in wing strength and decrease in total weight.

Sketch No. 1 shows a plan view of a model wing which has but a single spar as its main member or backbone. It does, however, possess two small stub spars as shown at fuselage end of the wing.

The stub spars and the main box spar, form the means by which the wing is attached to the fuselage of the model plane.

THE three spars are pushed into the fuselage fittings of tubular form made by wrapping doped tissue about forms of proper size and shape. The two stub spars are round while the box spar or main spar is rectangular in shape.

A sketch showing the round tapered stub spars is shown in drawing No. 10. They are fitted into ribs 4 and 5 shown in sketches No. 4 and No. 5, and secured there with ambroid cement.

The compression strut CS is used at rear stub spar and runs to the trailing edge of rib 4, as shown in drawing No. 1. This compression strut prevents the trailing point of rib 4 from flexing outwards towards the wing tip which condition is due to the pull on the trailing edge thread.

Likewise the compression strut CS, running from the trailing edge of rib 3 to the box spar where it is joined to rib 2 prevents the trailing edge of rib 3 from flexing inward towards the fuselage, which would be caused by the pull of the trailing edge thread.

The compression strut CS 1, braces the nose of rib 3 at the wing tip. This feature is desirable, as without causing too much weight to be incorporated at the wing tips it is well to have them strong.

Wing tips receive rather severe shock at times due to improper landings and strut CS 1 can take care of many blows which would otherwise result in the reconstruction of the wing tip.

THE purpose of the corner bracket marked *CB* is to strengthen the nose of rib number 4, allowing the reinforced leading edge to pull on a firm support. The reinforced leading edge is shown in drawing No. 11. It is formed by doping an extra strip of tissue over the noses of all ribs and also doping the edges of it fast to the box spar. This construction serves the same purpose as a plywood leading edge which is used on many planes and soaring machines.

The main purpose of this reinforced leading edge is to take care of the tensional strains or, in other words, the twisting of the wing caused by the shifting of the air acting on it.

The main spar is made by placing a piece of tissue on a soft wood table top and placing the cap strips of balsa wood shown in drawings numbers 7, 9 and 15 on it.

Hold these cap strips in place by means of pins on each side of it pressed firmly into the table top. The cap strips and pins are shown in sketch No. 15, as is also the tissue marked *E*. The cap strips are denoted by the letters *A* and *B*.

Vertical compression members shown in drawings No. 7, 8, 9 and 15 are placed between the top and bottom cap strips of the spar and held in place by means of pins as indicated in sketch No. 15. Do not forget to place the corner brackets in their proper positions as shown in sketches No. 14 and No. 15. These greatly stiffen the entire structure and assist in tying the cap strips firmly to the verticals just mentioned.

The K type braces are thin plates of balsa as shown in sketches 3, 12 and 14. They are placed in the centre of the spar as shown in sketch No. 12 and cemented in place with

THIS IS THE LAST OF A SERIES OF THREE ARTICLES ON BUILDING SUPER-LIGHT WINGS FOR MODEL AIRPLANES. THE OTHERS DEALT WITH A TRUSS BRACING SYSTEM AND CANTILEVER CONSTRUCTION, RESPECTIVELY.

their corner brackets. The purpose of these K plates is to prevent the top cap strip from pushing ahead of the bottom one, which would result in the canting of all the ribs and the collapse of the wing.

A K type bracket is placed at each end of the spar thereby producing a rigid structure.

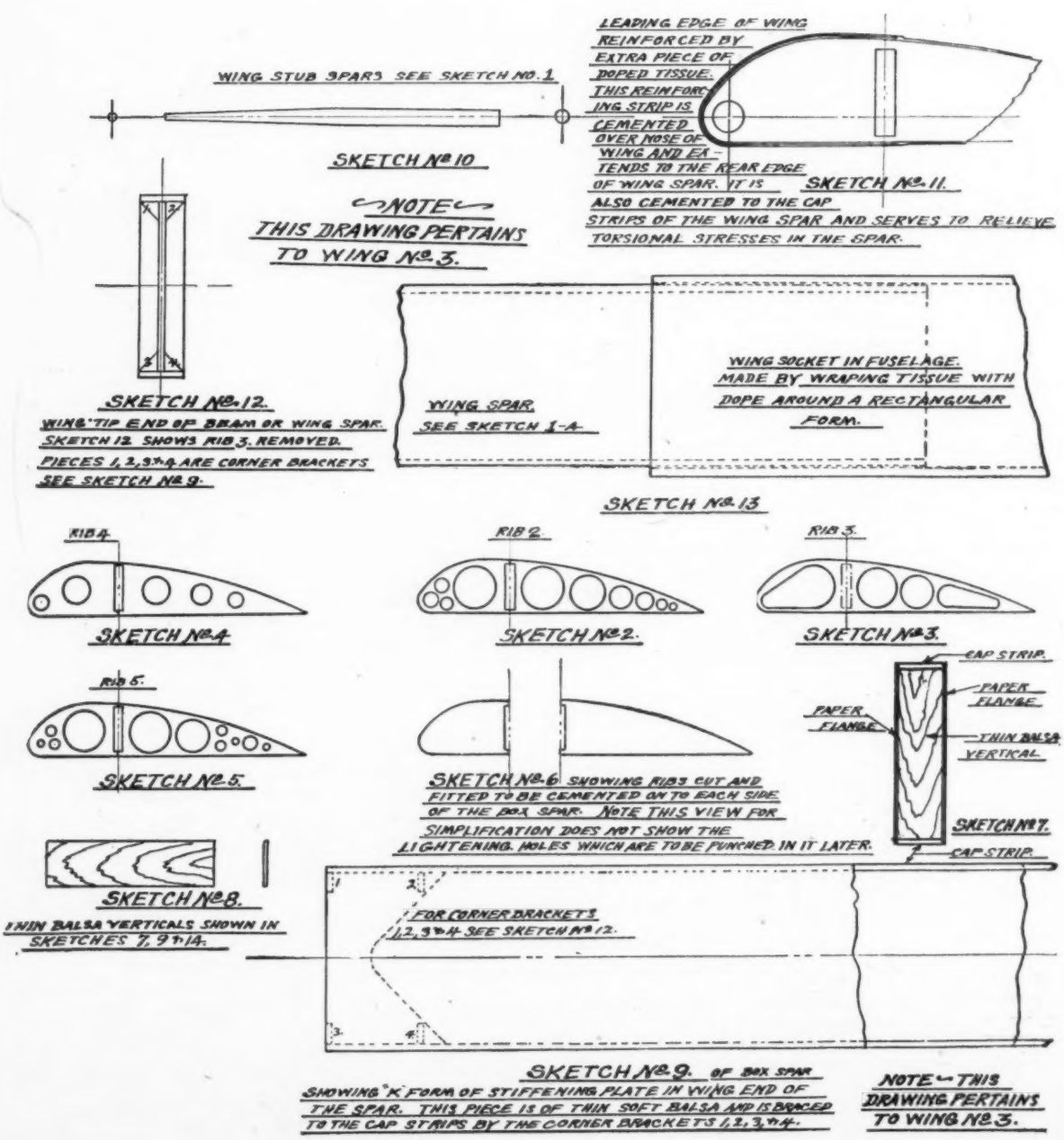
The spar as it now stands has the cap strips and paper cemented to them on one side; and the verticals are installed complete. Dope a piece of tissue and cement it on the other side of the spar, making a completely inclosed box except for the ends. The wing tip end of the spar is now closed by cementing rib 3 in place as shown in sketches 14, 1, 1a and 3. The dot and dash lines in sketch No. 3 show where the spar butt is cemented to rib 3.

It will be noticed that this rib closes the end of the box spar at the wing tip. The thread trusses are stretched taut on both sides of the box spar and doped to the tissue flanges as shown in sketch 1a.

They are marked 7d and the intersection point of the trusses in each box is marked A. It should be noticed that the thread is passed over and under each rib on each side of the box spar.

Each set of trusses is doped to the paper flange of the spar, forming an exceptionally rigid structure.

The ribs are cut and notched as shown in drawings No. 2, No. 3, No. 4, No. 5 and No. 6. All nose pieces are cemented to the spar and allowed to dry. The trailing portion of each rib is then cemented to the spar in line with the nose pieces.


WING STUB SPARS SEE SKETCH NO. 1.
SKETCH No 10
NOTE
THIS DRAWING PERTAINS TO WING No. 3.
LEADING EDGE OF WING REINFORCED BY EXTRA PIECE OF DOPED TISSUE. THIS REINFORCING STRIP IS CEMENTED OVER NOSE OF WING AND EXTENDS TO THE REAR EDGE OF WING SPAR. IT IS ALSO CEMENTED TO THE CAP STRIPS OF THE WING SPAR AND SERVES TO RELIEVE TORSIONAL STRESSES IN THE SPAR.
SKETCH No. 11.
SKETCH No. 12.
WING TIP END OF BEAM OR WING SPAR. SKETCH 12 SHOWS RIB 3 REMOVED. PIECES 1, 2, 3 & 4 ARE CORNER BRACKETS SEE SKETCH No 9.
WING SPAR SEE SKETCH 1-A.
WING SOCKET IN FUSELAGE. MADE BY WRAPING TISSUE WITH DOPE AROUND A RECTANGULAR FORM.
SKETCH No. 13
RIB 4.
SKETCH No. 4
RIB 2.
SKETCH No. 2.
RIB 3.
SKETCH No. 3.
RIB 5.
SKETCH No. 5.
SKETCH No. 6 SHOWING RIB 3 CUT AND FITTED TO BE CEMENTED ON TO EACH SIDE OF THE BOX SPAR. NOTE THIS VIEW FOR SIMPLIFICATION DOES NOT SHOW THE LIGHTENING HOLES WHICH ARE TO BE PUNCHED IN IT LATER.
CAP STRIP.
PAPER FLANGE
PAPER FLANGE
THIN BALSA VERTICAL
SKETCH No 7.
CAP STRIP.
SKETCH No. 8.
THIN BALSA VERTICALS SHOWN IN SKETCHES 7, 9 & 14.
FOR CORNER BRACKETS 1, 2, 3 & 4 SEE SKETCH No 12.
SKETCH No. 9. OF BOX SPAR
SHOWING "K" FORM OF STIFFENING PLATE IN WING END OF THE SPAR. THIS PIECE IS OF THIN SOFT BALSA AND IS BRACED TO THE CAP STRIPS BY THE CORNER BRACKETS 1, 2, 3 & 4.
NOTE — THIS DRAWING PERTAINS TO WING No. 3.

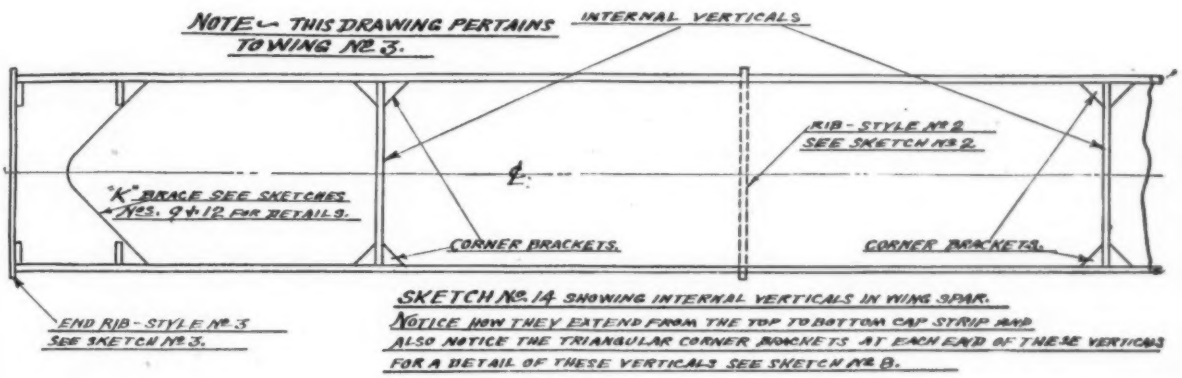
The reinforced leading edge which takes care of the bending moments in the wings is now made by cutting a strip of tissue wide enough to cover the noses of all ribs and extending from the under side of the wing spar over the nose and its edge is cemented to the top edge of the wing spar. This reinforced leading edge is shown in sketch No. 11. When thoroughly dry, the thread at the trailing edge is stretched in place and doped to the trailing edge of each rib.

THE wing is now covered and the tissue doped with thin airplane dope. The entire structure now presents a light but rigid wing, serviceable in every way.

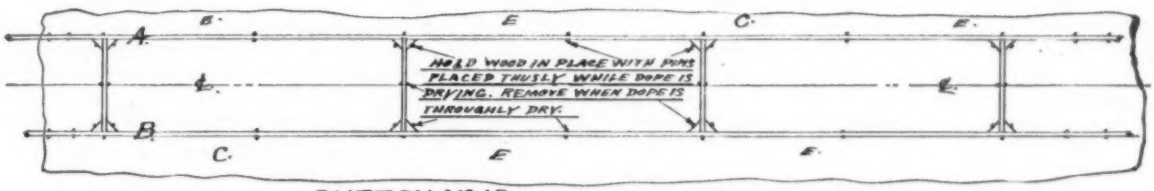
This system of wing construction may be applied to your next model plane; or your present models can be changed over by fitting them with wings of this design. These wings are best fitted to the fuselage by forming tubes from paper and dope to receive the spars of the wings. The tubes are cemented in the fuselage structure and the wing spars pushed into the sockets so formed.

A few pins passing through these tubes and spars serve to hold the wings in place on the model plane.

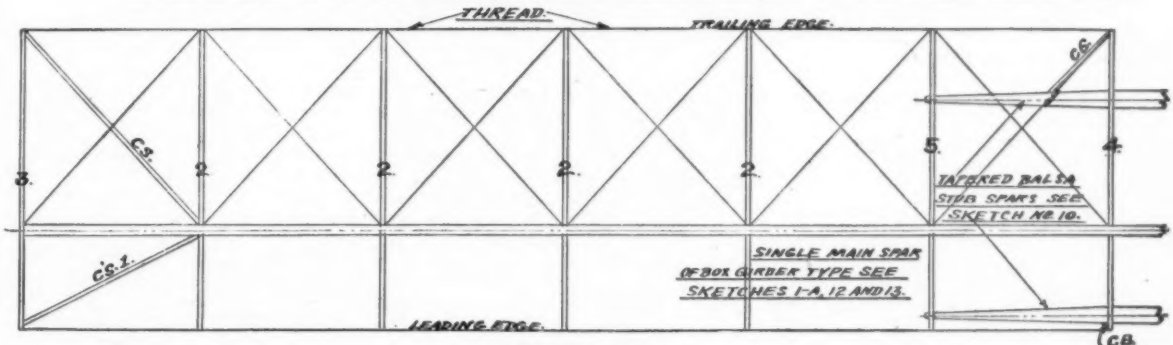
This article completes the treatise on super-light model wings.


NOTE ~ THIS DRAWING PERTAINS TO WING No. 3.
INTERNAL VERTICALS
RIB - STYLE No 2 SEE SKETCH No 2.
"K" BRACE SEE SKETCHES Nos. 9 & 12 FOR DETAILS.
CORNER BRACKETS.
CORNER BRACKETS.
END RIB - STYLE No. 3 SEE SKETCH No 3.

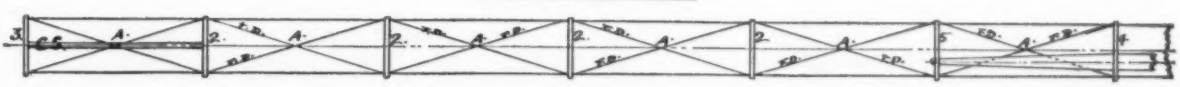
SKETCH No. 14 SHOWING INTERNAL VERTICALS IN WING SPAR. NOTICE HOW THEY EXTEND FROM THE TOP TO BOTTOM CAP STRIP AND ALSO NOTICE THE TRIANGULAR CORNER BRACKETS AT EACH END OF THESE VERTICALS FOR A DETAIL OF THESE VERTICALS SEE SKETCH No 8.



SKETCH No. 15 SHOWING HOW TO SECURE WOODEN CAP STRIPS UPON THE TISSUE "C" WITH PINS. THIS WORK IS BEST DONE UPON A TABLE TOP OF SOFT WOOD SO THAT PINS CAN EASILY BE PUSHED INTO IT. AFTER THE WOOD AND PAPER IS IN PROPER POSITION DOPE THE WHOLE ARRANGEMENT WITH THIN AIRPLANE DOPE WHEN DRY, TRIM OF THE EXCESS TISSUE "E". THIS RESULTS IN A SPAR WITH A TISSUE FLANGE ON ONE SIDE ONLY. IT IS NECESSARY TO COVER THE REMAINING SIDE WITH TISSUE DOPED IN PLACE.



SKETCH No. 1.



SKETCH No. 1-A.

~ NOTE ~
THIS DRAWING PERTAINS TO WING No. 3.

America's Ace of Aces

(*Continued from page* 17)

machines went out on October 2 over Sivry-sur-Meuse and Romaigne, and Rickenbacker accompanied them to observe their operations. To see them better he took a higher position and suddenly saw behind them a *Hanover* two-seater flying low and attempting to cross the American lines.

He immediately maneuvered to a position just behind the enemy without attracting his attention. When there was a distance of 100 yards between them, Rickenbacker aimed his two guns and fired. The observer was hit instantly and fell over the side of the cockpit. The *Hanover* banked and turned back for home, firing spasmodically, but Rickenbacker headed him off and again veered to a rear position. He set his guns and fired again. He was horrified to find that they had jammed!

He thought quickly and came up, forcing the enemy eastward. Reed Chambers, the leader of the patrol he had accompanied, appeared on the scene at the psychological moment, followed by the others. Chambers fired and killed the pilot. The enemy craft wavered and fell.

At once Rickenbacker became absorbed with his guns in order to right them as quickly as possible. Every moment in an unarmed plane might mean danger. In his preoccupation he did not notice a formation of eight *Fokkers* coming at him. They were less than fifty yards away when he glanced up. Instantly he spun out of range while they rained bullets at him. Down he went, not knowing what would happen next, intent only on getting away. Suddenly their fire ceased and he saw his patrol had again come to the rescue. Off went the *Spads* in pursuit of the *Fokkers*, which were fast gaining distance and making good their escape.

Chambers resorted to strategy, allowed them to go, and flew to the north for a point of vantage between them and the German lines. Rickenbacker followed and sought the shelter of the edge of a cloud bank. All waited for the enemy.

Suddenly out of the clouds came the formation. Chambers and Rickenbacker swooped under the tails of the rear *Fokkers* and fired simultaneously. Their shots told and the two *Fokkers* went down.

Three days later the *Hanover* which had been downed was visited by Rickenbacker and Chambers who wanted to examine the first of these two-seater machines to be captured intact by American flyers. It had glided down under control with little damage. One of the Germans had been killed and the other wounded.

October 9 brought Rickenbacker's next official victory, his sixteenth. He set a German observation drachen on fire while under the fire of enemy batteries himself, just back of Dun-sur-Meuse.

The famous Jagdstaffel No. 1, headed by von Richthofen, was daily seen in the vicinity, in addition to several other flying circuses, and there were so many encounters in the air that it is impossible to relate them all here. Suffice it to say that Rickenbacker's squadron justified its reputation.

It was natural that the American government should bestow one of its greatest honors on him, and so on October 19 Rickenbacker received the Distinguished Service Cross with four oak leaves. Hardly was the formality of the presentation over and he was off again for more victories.

Before long he had brought down in one encounter two *Fokkers* of von Richthofen's squadron, bringing his total victories to twenty-two. There followed more encounters with the same famous circus, and more victories for Rickenbacker. Then his belated commission as Captain of the *Hat-in-the-Ring* Squadron arrived officially.

Then came a lull. The end of October had much inclement weather and when the American flyers ventured forth under bad flying conditions, they found that their enemy was even more particular about the weather. The skies were invariably empty.

However, Rickenbacker managed to chalk up two more victories on October 30, 1918, bringing his total to twenty-six victories. These were his last.

On that day he had gone out on two morning patrols which had proved fruitless. Later in the afternoon he took up again, this time to watch from the rear the maneuvers which the First Flight of his squadron was to perform under a new leader. There were four machines in the formation and they meant to patrol the enemy's lines between Grand Pre and Brieulles at a fairly low altitude. On their third round trip, Rickenbacker saw in the distance two *Fokkers* flying low from the enemy's territory, very evidently meaning to attack the First Flight by surprise.

Rickenbacker waited his opportunity and remained out of sight in the clouds. However, he found that when the enemy swooped down on its prey, that he had left too much distance between them and himself, and could not possibly overtake them in time. Fortunately, the Americans managed to escape and make for home in safety. The *Fokkers* then headed for their own airdrome.

Rickenbacker had in the meantime edged further into enemy territory and, a favorite strategy of his, meant to surprise them by cutting them off as they neared their own lines. They were only about 1,000 ft. up and Rickenbacker saw them coming from his point of vantage of almost 2,000 feet altitude. He let them pass underneath him, then swung into action. He dipped over, came around as he lost height, and swooped with all speed on the tail of the nearest machine, firing almost simultaneously. In a moment the *Fokker* dropped to earth, the insignia of the von Richthofen squadron glinting in the afternoon sun as it fell.

The other *Fokker* dived for safety and escaped in his own territory. Amid the rain of gunfire from the enemy ground troops, Rickenbacker abandoned the chase and escaped unharmed. Making his way out of the enemy sector he spied a German observation balloon which had not yet been run up and which seemed deserted. He could not miss the tempting opportunity.

With instantaneous decision he pulled the triggers of his guns and fired as he came down to within 100 ft. of the drachen. It was a perfect target. He zoomed as soon as he saw that he had succeeded, and the balloon crumpled into licking flames. Rickenbacker then decided that home might be a good spot and headed for it before he should be discovered.

Night was coming on, and he had not gone ten miles when the most formidable of enemies presented itself—not a German flyer this time but a foe within his own camp, so to speak. His machine began to sputter. He looked quickly and was dismayed to find that his fuel was almost exhausted. Below him the enemy troops were sending up an occasional shot on the chance that he was an enemy.

Rickenbacker desperately sent up two red Very lights in the hope that his airdrome might see his signals. Just as he was giving up and the motor was gradually dying out, the landlights of his own airdrome lighted up and he was relieved to find that he was almost over the field. He managed to land safely.

The heavens still poured rain for some days and there was no flying until November 8, the same day that the news was bruited about that the Armistic had finally become an actuality. For weeks the men had felt that the end of the war was in sight and at last it had come.

Then came the breaking-up of his squadron whose name had resounded everywhere with the fame of its deeds, and Rickenbacker left the helm of his ship of war with his memories. His fame was re-sung last year when he was presented with the Congressional Medal of Honor, America's highest distinction.

The Buhl Bullpup

(*Continued from page* 30)

for the wings. The Buhl Co. uses N.A.C.A. Munk-12 type airfoil section. See Fig. 8. Cut sixteen ribs of 1/16 in. soft or 1/32 in. hard balsa sheet. The leading edge is made of ⅛ in. square, and the two spars are 1/16 x 1/4 in. strips. The trailing edge is made of 1/8 x 1/16 in. and must be tapered.

Drawings 7 and 8 show one wing frame. Build one right and one left wing. The wing tips are made of 1/16 in. square bamboo and the last ribs are made only of 1/16 in. square balsa. Both sides of the wings are covered with tissue and doped. The next step is to glue the two wings to the fuselage.

Give ⅞ in. dihedral for the wings and an angle of attack. This can be done by placing the model in flying position. The distance from the ground to the leading edge must be 7/16 in. more than from the ground to the trailing edge. The model needs neither wash-out nor wash-in.

After the wings are fastened, place and glue 4-4 black threads on each wing. Two-two on top and two-two at the bottom of the wings. See Fig. 8, "R" and "S." The other ends of these threads are fastened and glued to the cabane and to the fuselage ("A").

Now your model is ready for the test. Before testing see that the center of gravity is in the same position as shown in the drawing. Lift the model by the wings to find the horizontal location of center of gravity; then lift by the tail to find the vertical position. If they do not correspond with the plane as shown in drawing 2, use small weights to bring the model to the proper equilibrium.

If you find it perfect, you can try your *Bull Pup*. Give the motor 100 turns and release on the ground. If you have followed the instructions carefully, your model will take off and fly. Tests can be made with 300 or more turns and also hand-launched.

(Continued from page 36)

mighty handy later on, even if you do not become an airplane designer. They explain many everyday mysteries and enable one to understand dozens of things that were misunderstood or misinterpreted before, often with painful or fatal results.

For those of you who go to engineering college, the following articles will be invaluable. If you study them carefully you will have the jump on the other fellows when you go into competitive classes. You will know just what you are doing and why you are doing it; they will be fumbling and will lose time by doing so.

Now, before we start, just a word about the profession of engineering.

An engineer need bow to no one. He combines the practical knowledge of the past with the vision of the prophet. From the brains of engineers have come the machines and devices that have put mankind where it is today, and will raise it to a higher scale of accomplishment and happiness in the future. The doctor is useful when it comes to patching up disordered human machines. A lawyer can do his part by helping to settle the squabbles that continually arise between mortals.

However, without the engineer, mankind would get nowhere. What if we had no trains, no steamships, no lamps, no stoves, no glass, no water pails, no looms to weave cloth, no roads, no houses?

Then, when you tackle the job of learning to use the engineer's tools, remember that your future job is one that nobody need be ashamed of. It is, and will be, hard work. However, if it were not hard work it would not be worth the trouble and you, who plan to be an aeronautical engineer, are aiming at the best, most interesting, and, in the near future, the best rewarded job in the engineering profession.

Course in Airplane Designing

One thing more; don't be afraid of mathematics. The basic tools of engineering are fairly few and fairly simple. After all, they consist mainly of common sense, and your only difficulty will come from the fact that you have never stopped to think about *how* and *why* things happen in this world. Do the job slowly and thoroughly, and you will be glad you spent the time on it.

Remember this: fully ninety per cent. of all engineering work is accomplished with mathematics no more advanced than addition, subtraction, multiplication and division. Of course, there are cases where complicated mathematics come in—the stress analysis of an airplane fuselage is one—but in this course it is our object to learn how and why things are done rather than to delve into the complexities of the subject that can better be learned later on.

After all, a football player may take the ball and exhibit matchless skill as he sidesteps and dodges and uses his head in running seventy yards for a touchdown; but if he doesn't know which way to run, and thereby takes the ball across his own goal line, we would say that he was dumb in spite of his knowledge and skill in the matter of broken-field running.

Engineers deal with *forces*. The airplane designer, for example, knows that the plane must be supported by its wings. He figures out the wing area and the air speed and presently decides that there is a certain *lift force* developed to keep the ship in the air.

First of all, then, we must know what a force is. Every one of us has a more or less definite idea on that subject, but when we try to put that idea into words we run into trouble. If I push on a wall with a force of five pounds, anyone knows instantly that I am exerting a force that would pull a spring balance needle down to the five-pound mark.

Looking in the dictionary, we find something like this; a force is a cause that brings about motion or change of motion, or tends to bring about motion or change of motion.

How does that sound? Saying that a force is "a cause" seems to me like saying that cod-liver oil is "the reason" for a lot of discomfort. In both cases, provided we know what the thing is beforehand, we can understand the definition. But if we do not know just what the thing is, we are as badly lost as ever.

While the dictionary definition is quite correct, it might be clearer for our purpose to go back and begin at the beginning.

What is the most common force we know of here on earth? Gravitation, of course, the force that pulls our bodies down to the ground and holds them there or that holds them against any object, such as a floor, that may be between them and the ground. If an object weighs one pound we know that gravitation pulls that body toward the earth with a force of one pound; hence, when supported by scales, the body is pulled down with that force and in turn depresses

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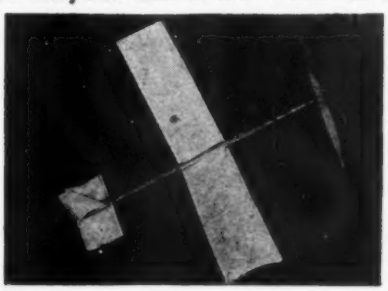

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1/8"	½c	10c	1/4"	1c	20c
3/16"	½c	10c	1/4x1/4"	1c	20c
1/4"	½c	10c	3/8"	3c	45c
3/32x3/32"	½c	10c	3/8x3/8"	3c	45c
1/8 x 1/8"	½c	10c	1/2"	2c	45c
3/16"	½c	15c	1/2x1/2"	2c	45c

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PROP BLOCKS

3/8x3/4x6"	1½c	7/8x1½x10"	5c
5/8x1x6"	1½c	3/4x1¼x12"	6c
5/8x1x8"	2c	7/8x1½x12"	6c
3/4x1¼x8"	4c	7/8x1½x14"	8c
3/4x1¼x10"	4c	1x2x14"	10c

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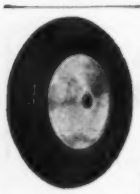

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the scales with that force.

There we have the idea. There are two objects: the one-pound body and the earth. Between those two there exists a pull of one pound. We don't know, yet, just why that pull exists; but it is there and we are glad of it, because we would have a difficult time if it were not for gravitation.

Then we say this: a force is an attraction or a repulsion between two objects. That definition has one or two exceptions, centrifugal force being one, but in these cases it will still apply, as we shall see later.

Look at Figure 1. Here a weight is suspended by a string. The weight is a square chunk of iron and it weighs five pounds. What is the force, then, in the string?

"Five pounds," we say, instantly.

Why? That is the question that set a man by the name of Isaac Newton, back in the seventeenth century, to thinking. Tradition has it that an apple beaned Newton and started his mental machine on the problem of "why?" but it is more likely that Newton, being a clear-sighted and keen-minded chap, needed no such shock to arouse his curiosity.

He mulled over the various phenomena of falling bodies and forces and motion, and there blossomed forth three laws that have stood unshaken ever since. They are not laws in the usual sense, being natural laws and not the man-made variety; and they are the fundamentals of all engineering work. One of them is, boiled down, simply this: *Everything is in equilibrium.*

The Consolidated *Commodore*

(*Continued from page* 14)

4 is ¾ in. long, and 5 is ½ in. long. A duplicate of each nacelle brace is required for the other motor bracing.

For the wing braces or struts note that they are identified in the drawings as A-1, A-2, B-1 and B-2, etc. One and two braces are so called because one is placed in the front under the leading edge of the wing, while two is placed directly behind it (see drawings). Both one and two are of same dimensions. The sizes of the bracing struts are as follows:

A 1-2 1/8 x 3/16 x 4½ inches.
B 1-2 1/8 x 3/16 x ¾ inches.
C 1-2 1/8 x 3/16 x 2⅜ inches.
D 1-2 1/8 x 3/16 x 1½ inches.
E 1-2 1/8 x 3/16 x 2¼ inches.
F 1-2 1/8 x 3/16 x 2½ inches.
G 1-2 1/8 x 3/16 x 1¾ inches. (2 pieces required)
H 1-2 1/8 x 3/16 x 1⅛ inches. (2 pieces required)

(Note: All braces cut to the dimensions given above with the exception of G and H are four in number.)

Dimensions for the tail group bracing struts are as follows:

A 1-2 1/8 x 3/16 x 1¾ inches.
B 1-2 1/8 x 3/16 6x 1¾ inches.
C 1-2 1/8 x 3/16 x 1⅜ inches.
D 1-2 1/8 x 3/16 x 2 inches.

Assembling

In assembling the model it is best to start with the wing first. The wing which by now should be strongly glued together is rested on the wing braces H 1 and 2 and glued. Put blocks of wood or books at each wing tip to prevent the wing from tipping over before being permanently set.

Then insert the nacelle braces into the nacelle and glue them to the center section. Have the motors in line and be sure that they are 1¼ inches apart from brace H, measuring from the brace to the outer part of nearest cylinder. Allow plenty of time for nacelles to harden in place.

Now attach the small pontoons to each side of the hull by bracing F 1 and 2. The braces C 1 and 2, D 1 and 2 and E 1 and 2, etc., are then installed in position and glued. Last of all the main wing struts A 1 and 2, B 1 and 2 on each side of the wing are glued and set in position (see plans). This completes the wing and motor assembly.

The tail assembly is simple. The main vertical fin is glued on first as illustrated in the plans. The horizontal stabilizer is next into position. Bracings A 1 and 2, etc., are then glued in their proper positions. The rudders are then glued in an upright position. They are kept in place by brace struts D 1 and 2. This now completes the tail group assembly.

Finishing Touches

Before painting the model, use a sharp pencil and ruler to mark out the ailerons, center section, vertical fins from the rudder, stabilizer from elevator, etc. As for the windows on the sides of the hull, they may be either painted on or pasted.

Painting and Completion

The colors given here are the stock colors of the real ships in service. However, the model may be painted in any color combination. The wing is given two coats of chrome yellow. The hull is painted cream yellow (a mixture of yellow and white). The side pontoons are also cream yellow. Both hull and side pontoons have their water lines painted black or dark blue. The tail surfaces are chrome yellow. The motors are painted a shiny black and the nacelles are painted silver. All the braces are cream color. Propellers are finished in silver. The tips are painted red and blue. The aileron, elevator, rudder, outlines are gone over in black ink to make them outstanding.

N Y R B A LINES is painted on each side of the hull in black. A black arrow runs through the letters. The painted model finished off with a coat or two of varnish will be a pleasing sight to any eye.

Material List

1 piece wood, ½ x 3 x 26 in., wing.
1 piece wood, 2 x 2½ x 15 in., hull.
1 piece wood, ⅛ x 2 x 6 in., elevator.
2 pieces wood, ⅛ x 1½ x 1½ in., rudders.
1 piece wood ½ x 1 x 1½ in., main fin.
2 pieces wood, 1 x 1 x 2 in., motor nacelles.
2 pieces wood, ¾ x ¾ x 4½ in., side floats.
2 pieces wood, 3/16 dia., dowling 2⅜ in. long.
Dowling and bamboo (see text for dimensions), bracing struts.
1 can ambroid glue, 3 grades sandpaper, 3 in. square celluloid, 1 piece sheet balsa 1/16 x 2 x 6 in., cork, soft copper wire, model making pins.

(*Continued from page 34*)

wide open space is essential without too many surrounding obstructions that will obstruct the view of the planes in flight. Secondly, the ground must be kept clear of spectators for a reasonable area.

Too many low flying planes that may or may not gain altitude have their flights abruptly halted by striking spectators. This is not fair to the owners, who have a right to expect a reasonably clear space in which to make their attempts. If trees or buildings are nearby, both the judges and the planes are handicapped.

Standing records probably are being broken by planes which are no longer in the view of the judges, and credit can only be given for flights which are officially witnessed. Incidentally, even boys do not relish climbing trees or buildings too often to rescue their models, and the spectator, too, prefers a contest which he can watch from beginning to end.

There should also be a space where entrants can make any trials they wish before entering the actual contest. Too much confusion results if they do this in the same space reserved for the contests.

Contests should be run off to schedule as far as possible, and entrants lined up ready with their planes a few minutes before the time set for a start. One attempt only should be allowed each entrant before following on with the next contest.

At a later period on the program second attempts in the same class should be made, and still later, the third and final attempts. Working it in this manner gives the judges a chance to maintain an approximate schedule, and also allows each entrant a fair time for repairs between each attempt.

American Sky Cadets

From the point of view of the model airplane builder, it would seem that more attention should be given to stability and ruggedness of construction, even at the sacrifice of speed and duration.

With the conditions existing for the average outdoor contest, unless the plane is tolerably stable under adverse conditions, it is of little avail that it is able to maintain flight for five minutes in still air. Even a model airplane will have little success unless it is able to stay the right side up.

So far as ruggedness of construction is concerned, this is usually only obtainable with increased weight, and consequently reduced performance, but it is better to have a tolerable chance under average weather conditions, than a better chance under only exceptional conditions. Those who have seen their hours of work destroyed in a flight of a few seconds will appreciate this.

The trend in model building today seems to be towards larger and sturdier models, and this, I think, is a good sign. Those minute fractions-of-an-inch errors in dihedral, will have a smaller effect on the larger models than on the smaller types, and further, the maker has a better opportunity of studying the aerodynamics of the craft he is building.

The planes at the Brockton Fair did not have an opportunity to show their qualities to the full, but nevertheless the average standard of performance was high. It was particularly noticeable how all the successful flights were made by planes which were able to gain altitude.

The following is a list of the winners in the different classes:

Junior Stunt Flying—Peter Mollis, 1; John Ford, 2; Edward Denahey, 3.

Junior Fuselage Models—Arthur Giard, 1; William Bishop, 2; Albert Malouin, 3.

Senior Hydroplanes—Donald Brunton, 1; Chester Wolowicz, 2; Stanley Usis, 3.

Junior Hydroplanes—John Ford, 1; John Bartol, 2; Albert Malouin, 3.

Junior Hand-Launched Models—John Ford, 1; John Bartel, 2; Albert Malouin, 3.

Senior Stunt Models—Everett Haydon, 1.

Planes Powered With Other Than Rubber—Stanley Usis, 1; Chester Wolowicz, 2; Everett Haydon, 3.

Junior Scale Models—James Nye, 1; John Hatherway, 2; Roy Washburn, 3; Wain Johnson, honorable mention.

Senior Fuselage Models—Donald Brunton, 1; Chester Wolowicz, 2; Everett Haydon, 3.

Senior Scale Models—John Turner, 1; Marius Trinque, 2.

Senior Hand-Launched Models—Donald Brunton, 1; Bruno Marcki, 2; Everett Haydon, 3.

Brockton versus The Rest—Albert Malouin, 1; Everett Haydon, 2; John Ford, 3.

The winning scale models in the junior contest were Boeing Pursuit ships first and second, and an autogyro third. A Sikorsky amphibian received honorable mention. The decision of the judges in the senior class wavered between a Travelaire and a Stinson *Detroiter*. The first was, perhaps, a better piece of construction with its covered wings, movable joystick and instrument

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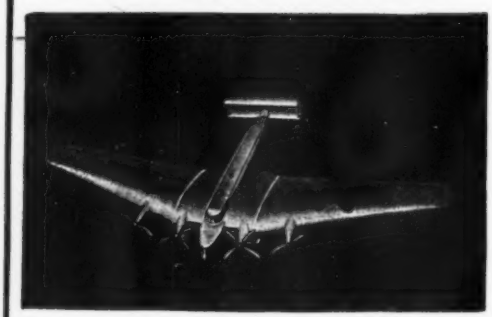

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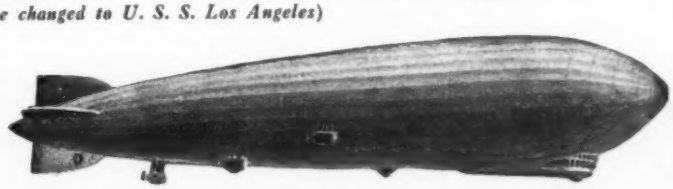

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board, but, unfortunately, the owner had omitted to include registration numbers and the motor was not of the correct design.

These are important items in scale models so the decision was finally given to the Stinson *Detroiter* plane, which was also a remarkably fine piece of workmanship.

As a model airplane contest the meet was a complete success. In consequence of the gusty weather repair kits were kept busy, but who cared? Certainly not the model airplane enthusiast.

Aerial Radio Course

(*Continued from page 22*)

charging circuit through which a current is passing and dip them in a glass of water to which a few grains of salt have been added, taking care that the wires do not touch. Small bubbles will rise from the negative wire.

Maintenance

The maintenance of batteries not required for immediate use will depend on whether they are to be kept in wet or dry storage. In the latter case it will mean taking the battery apart. If its condition is such that this would have to be done soon anyway, it will be best to put it into dry storage, as once this has been done no further attention need be given it for a considerable period.

If the battery is likely to be required for use shortly, or its condition is good, it will be best to keep it in wet storage. This is done by placing the batteries on a shelf on wood strips to keep the bottoms clear of the shelf. The proper level of the solution must be maintained and the batteries given a periodical charging. The wiring should be arranged so that they can be charged without moving. Keep them clean and the connections smeared with vaseline.

Never expose batteries to strong sunlight or temperatures higher than 110° Fahrenheit as this will deteriorate the plates.

The attention necessary to a battery after it is received from the makers will depend upon how the battery has been shipped. The makers generally include complete instructions for putting into service any batteries sent out by them.

A battery of good make will rarely give trouble provided it is kept in proper condition. Troubles connected with batteries will generally be found to be the result of corrosion, poor connections, leaks or grounding in the wiring. If examination fails to bring to light any of these faults, it may be that the battery itself will need opening.

So far as batteries for ordinary radio purposes are concerned, we will deal with this in a later article.

With batteries used in airplanes, owing to the limited space the plates and separators are of very thin material and correspondingly fragile. It will generally be better to return aircraft batteries to the makers than to attempt repairs which involve taking them to pieces.

[The author wishes to make acknowledgment to the manufacturers of the Exide battery for permission to publish copies of illustrations and diagrams prepared by them which he has included in this article.]

The "Scrambled" Picture Contest

(*Continued from page 00*)

Picture No. 2 was that of a Curtiss-Wright *Sedan*, equipped with a 185 horsepower Challenger engine.

Picture No. 3 showed a Curtiss *Kingbird*, equipped with two 300 horse-power Wright Whirlwind engines.

Picture No. 4 showed a Curtiss-Wright *Sportsman*, equipped with a 125 horsepower Kinner engine. The *Sportsman* is a three-place job which is also built to take a Warner or a Whirlwind engine.

Picture No. 5 depicted a Curtiss *Hawk* (Army) P6, equipped with a Prestone-cooled 600 horsepower Curtiss Conqueror engine.

Picture No. 6 showed a Marine Corps Curtiss observation plane equipped with a Curtiss Chieftain engine.

Naturally we haven't given you the fullest identification here, as it is quite possible that someone might be able to get a copy of this issue before the closing date for sending in complete solutions—December 23.

As you know, MODEL AIRPLANE NEWS is on all newsstands on the 23rd of the month preceding the date of issue.

However, don't forget to watch for the next issue containing the final results of the contest. Make sure of obtaining your copy now by leaving an order with your newsdealer to reserve it for you. Don't forget—February MODEL AIRPLANE NEWS, on all newsstands January 23 next, and only 15c. a copy.

Airplane Engines

(*Continued from page 8*)

degrees Fahrenheit or in Centegrade.

As the vapor-pressure type thermometer is not entirely accurate at low temperatures or at high altitudes, it is used mostly to indicate water temperature.

It is more important for the pilot to know accurately his oil temperature. For this reading the liquid-pressure type thermometer is mostly used. The bulb in this case is entirely filled with a liquid such as mercury or alcohol. As the liquid becomes heated it will expand, thus creating a pressure which will tend to straighten out the Bourdon tube. This in turn will move a pointer which is read by the pilot in degrees of temperature.

Other types are in use to some extent. Among these are the gas-pressure and the electric thermometer. The latter is much used in Germany.

It is an American practice to insert the oil temperature bulb in the lubrication system just aft of the pressure pump. This indicates the temperature of the in-going oil. If this is sufficiently cool, the pilot is assured that his engine is operating satisfactorily. On the other hand, if the in-going oil is too hot it signifies that the engine is heating up internally, that an oil radiator or cooling system should be used, or that the oil supply is dangerously low.

On a water-cooled engine, however, the water temperature bulb is placed at the top

of the water jacket which will ordinarily be the hottest part of the system. This is done because after the water passes through the radiator its temperature will depend on a variety of factors, such as the atmospheric temperature, the speed the plane is moving through the air, and the like. Consequently, the cooled water would give no indication of the actual heat conditions within the cylinder.

Practically all modern installations give the pilot a certain amount of control over the temperature of his powerplant. As an example, the air-cooled engines generally have radial shutters which cover the forward section of the engine. The pilot has a small wheel which will open or close these shutters. Similar arrangements are provided for varying the amount of cooling surface offered to the airstream by the water radiator.

In some military designs the pilot can even draw his radiator up inside the fuselage. Not only can the operator keep his engine temperature constant, but he also is enabled to reduce his head resistance. In some designs an oil radiator is required. Again the pilot is provided with shutters in order that he may control his oil temperature.

One of the things a pilot likes to know at all times during his flight is the quantity of fuel remaining in his tanks. Knowing this accurately, he knows the range of his ship at all times. He will have sufficient warning to permit him to land and replenish his supply of fuel, thus avoiding a forced landing.

It is unfortunate that few, if any, types of fuel gauges are satisfactory under all conditions that must be fulfilled. This is the reason that practically all pilots fly with one eye on a watch. Knowing the fuel consumption of the engine, the pilot can estimate how many hours he can fly with a certain fuel load. Thus, aviators speak of two cities being so many hours apart instead of referring to actual mileage.

Probably the most used fuel depth gauge is the pressure or hydrostatic type. It is extremely simple in its operation and functions because of the fact that the pressure exerted by a volume of liquid is directly proportional to its depth. It consists primarily of a hollow tube standing vertically in the fuel tank. This tube is connected to the gauge dial in the cockpit and to a small hand pump.

Naturally, the liquid surrounding the tube will attempt to force its way up into it. As it does, it exerts a pressure on the air which in turn conveys it to the dial in the cockpit. The dial is calibrated in gallons.

Perhaps a gauge glass would be the simplest form of a fuel gauge, but the fire hazard of this type makes it impractical. The float and gear type used on automobiles are not feasible because of the violent maneuvering the airplane is called upon to perform.

The powerplant instruments which have been described are those which are essential to the pilot if he is to attempt flight with any safety. They will mean the difference between life and death. Undoubtedly there are many home-made airplanes which do not mount the necessary instruments. Every flight they make is hazardous.

The more responsible the mission which an aircraft is called on to do, the greater the number of instruments which will be

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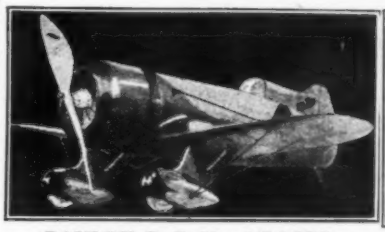

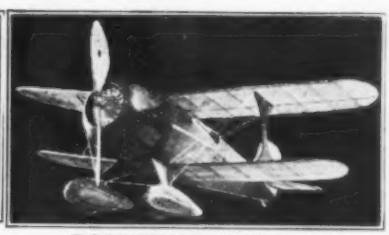

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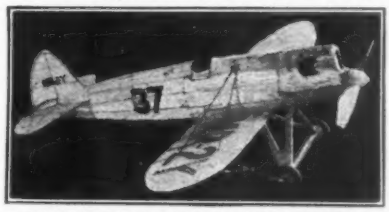

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ERROR

Model Airplane News understands that many of its readers were puzzled by a printing mistake in the **Cleveland Model & Supply Co.** advertisement appearing on the back cover of the November, 1931, issue. The sentence reading "N-D for Best and Latest Model Aircraft Cata'ogue." should be read "**Send** for Best and Latest Model Aircraft Catalogue."

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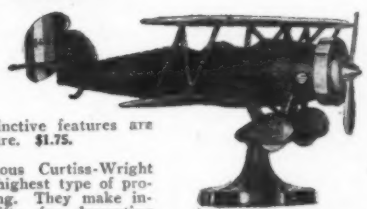

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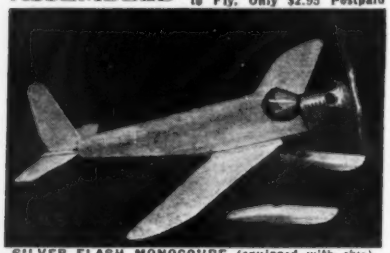

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used. Whereas only the more important can be described in this article, due to space limitation, a great many more could be described which are important to the well trained pilot. As an example, the cockpit of Frank Hawk's speedy Travelair *Mystery Ship* is so full of dials and gauges as to resemble the control board of a power house. Army and Navy ships are similarly crowded. Each of the dials contributes knowledge and control to the pilot, if used properly.

We have all been hearing reports of the new Packard Diesel engine during the past two years. It appears to have many advantages over the gasoline engine which is used at the present time. It seems not unlikely that the Diesel engine will come to be widely used. The following article will be a complete description and discussion of this important engine.

Aviation Advisory Board

(*Continued from page 35*)

achieved. They have already broken the records for duration without refueling, for duration and distance over a closed course with loads of 500, 1,000 and 2,000 kilograms, and they are to be used in an attempt to break the records for duration and distance in a straight line, records now held for France by the Breguet 19, "Question Mark."

The Bleriot 110: This is an all-wood high wing monoplane, with a wire-braced wing and a monocoque fuselage of elliptical form. It is equipped with a 600 h.p. Hispano engine, ungeared metal propeller, and normal landing carriage and tail surfaces. In this machine was established a record of 75 hrs. 22 mins. duration, which stood until the recent 84-hr. flight of Messrs. Lees and Brossy in a Packard-Diesel-engined Bellanca.

The Bleriot 110 has a span of 866 feet, a total weight of 16,000 lbs., of which 10,000 is useful load, has a maximum speed of 132 m.p.h., and carries 1,820 gallons of fuel. Its theoretical maximum range in still air is said to be 7,500 miles, and its ceiling with full load is 6,500 feet.

The Dewoitine D-33: An all-metal, low-wing cantilever monoplane, this machine is entirely different from the Bleriot described above. It has a 650 h.p. Hispano engine driving an ungeared metal propeller. Its total weight at the take-off for its record flight was 20,000 lbs., of which 13,200 lbs. was the disposal load. It carries 2,100 gallons of fuel, 795 gallons of fuel were sealed off to make a load of 2,000 kg. (4,410 lbs.) with which load the airplane remained in the air for 32 hours and 17 minutes.

The Dewoitine D-33 is particularly interesting from a structural standpoint, having a tapered, unbraced, all-metal wing of 91-foot span with an aspect ratio of almost 10, having only a moderately thick section. The wing has a single spar, and it is said that its construction was made possible only after an exhaustive study of tortional characteristics. The fuselage is of semi-monocoque construction, likewise all-metal, and it has an enclosed cabin. It is of very clean design, with rather small cross section, and it looks distinctly small in comparison with the gigantic wing. The undercarriage and tail are normal. The performance has not been announced, but it is believed to be unusually good.

The Bernard 80-GR: This airplane is an unbraced, middle-wing monoplane, of very clean design, having the Hispano 650 h.p. engine. The construction is of wood, and the wing and fuselage are covered with plywood. The landing gear is highly streamlined, and of very wide track. The machine has the same empty weight as the Dewoitine D-33, but it carries somewhat less load, and with a slightly smaller wing area it has a higher speed. The span is 80 feet, the wing area 750 sq. ft., the weight empty 6,800 lbs., loaded 18,800 lbs.

It has a high speed of 153 m.p.h., which is most remarkable for the weight and power of the machine. It was used to break the record for distance over a closed course, covering 5,560 miles in 59 hours and 14 minutes, thus breaking the record set by the longer flying, but slower, Bleriot 110. It was forced down with 3 hours of fuel left in the tanks, due to evaporation of the cooling water. The fuel capacity is 1,980 gallons.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912,

Of MODEL AIRPLANE NEWS published Monthly at Springfield, Mass., for October 1st, 1931. State of New York, County of New York.

Before me, a Notary Public in and for the State and county aforesaid, personally appeared Herbert S. Clark, who, having been duly sworn according to law, deposes and says that he is the Business Manager of the MODEL AIRPLANE NEWS and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher, Good Story Magazine Co., Inc., 570 Seventh Avenue, New York, N. Y. Editor, Capt. H. J. Loftus-Price, 570 Seventh Avenue, New York, N. Y. Managing Editor, Harold Hersey, 570 Seventh Avenue, New York, N. Y. Business Manager, Herbert S. Clark, 570 Seventh Avenue, New York, N. Y.

2. That the owner is: Model Airplane News Publishing Co., 1926 Broadway, New York, N. Y. Macfadden Publications, Inc., 1926 Broadway, New York, N. Y. Bernarr Macfadden, 1926 Broadway, New York, N. Y. O. J. Elder, 276 Harrison Street, East Orange, N. J.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is. (This information is required from daily publications only.)

Herbert S. Clark, business manager. Sworn to and subscribed before me this 1st day of October 1931. Philip Rosenthal. (My commission expires March 30, 1932).

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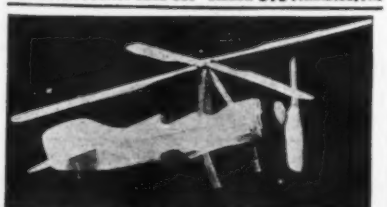

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(*Note: It is reported that the Dewoitine D-33 has since broken this distance record by traveling 6,510 miles over a closed course in 71 hours, 13 minutes.*)

GREAT BRITAIN.

The Parnall Parasol Research Monoplane: One of the most vexing problems of aerodynamic research is the presence of "scale effect," which is a difference of more or less indeterminate magnitude which exists between small-model wind tunnel tests and the full-sized article. Many means of offsetting this effect have been used, notably the full-sized tunnel and the high-pressure (variable density) tunnel of the N. A. C. A. There have also been numerous attempts at towing full-sized airfoils under an airplane, and measuring the force reactions directly.

The Parnall Parasol research monoplane is a straightforward attempt at a solution of this problem, consisting of a normal airplane fuselage, power plant, and tail, upon which is mounted a single wing, the mounting being so constructed that the forces of lift and drag can be measured in flight. The complete wing structure has a small amount of freedom which is normally restrained by a dynamometer, which measures the resultant wing force.

In addition to allowing certain scale-effect comparisons, this machine can also be used to co-ordinate wing characteristics that are difficult to determine in wind tunnel tests. It will undoubtedly be an economical mode of research, since its first cost and upkeep will be much less than those of a wind tunnel.

The airplane is normal in all respects, being a two-seater with a super-charged Armstrong-Siddely "Lynx" engine of 220 h.p. It weighs 2,900 lbs. loaded, and has a speed range of 50 to 120 miles per hour.

U. S. S. Akron

(*Continued from page 5*)

War the Goodyear Company was interested in the building of lighter-than-air craft. At one time about 2,000 persons were employed in that balloon room of the factory, and nearly 1,000 balloons and 100 motored airships were built. In 1923 the construction of the first semi-rigid airship was started, and in the same year American rights for full rigged ships were acquired from the Luftschiffbau-Zeppelin, Friedrichshafen, Germany, the largest constructors of Zeppelins in the world.

In 1927 an appropriation of $200,000 was made to start construction, and first place was awarded to Goodyear in an airship design competition held by the Navy and open to the world. Then the item of $8,000,000 was included in the naval appropriation bill for the construction of two ships, and the contract was awarded to Goodyear in October of 1928.

These sister ships of the Navy, the ZRS-4 or *Akron*, and ZRS-5 (to be built) will be the largest dirigibles ever built. In cubical content the *Akron*, is about twice the size of the *Graf Zeppelin*, and two and a half times as large as the *Los Angeles*. The maximum speed of the *Graf Zeppelin* is 80 miles an hour, while the new ship will do nearly 84 miles, and at a speed of 50 miles an hour can travel 10,580 miles without refuelling. The *Graf Zeppelin* can make but 6,125 miles without refuelling.

The material used in the construction of

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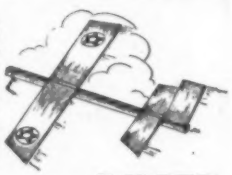

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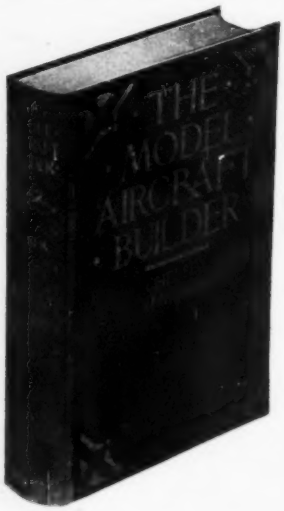

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the *Akron* is duralumin, an extremely light weight metal, resembling, as its name indicates, aluminum. Strips of the metal are perforated to make still lighter, yet enough of the metal is left to retain their strength. These strips, of uniform length, are riveted together in fours, along their length, to make a hollow unit, square at the end, and several feet long. These are called girders, and of these the frame work is made, the metal units fastened together at the ends to make transverse rings connected by longitudinal girders, the latter extending the length of the ship.

There are 12 gas cells in the ZRS ships. The ring girders are large enough to form corridors for the crews to climb entirely around the circumference of the ship for inspection or repairs. Auxiliary to the main girders are intermediate rings of the single girder type. These are merely to stiffen the longitudinal girders, the main rings carrying all the load. Hundreds of miles of handwound wire form a network connecting the rings and girders, augmenting the strength of the structure.

The control car is placed forward, being built as an integral part of the ship. Here the commander and his staff have their stations, directing operations. Every latest device known for efficiency and safety of navigation is contained in the control car. It is only large enough to comfortably take care of these operations. Radio cabin and officer's quarters are placed directly over the car inside the hull. Near the middle of the ship are located rooms for officers and crew. Each sleeping room contains four comfortable berths. A galley and mess room make complete living quarters for the airmen.

A novel feature of the design of the Navy airship is a compartment about 60 x 75 ft. for the storage of five completely assembled airplanes. Collapsible doors in the bottom of the ship cover a T-shaped opening through which a trapeze with an airplane attached can be hoisted or lowered. The airplanes may attach or detach themselves from the trapeze while in flight. This feature greatly increases the value of an airplane for scouting purposes.

The covering is a thin, but strong fabric, doped and metalized, which makes it waterproof and protects it against the elements, reflecting instead of absorbing heat, as well as making a wonderfully smooth surface. Beginning at the nose of the ship, the covering is put on in sections, laced together and tightened in order to stretch it smoothly over the steel frame. It is painted with "dope" five times, the first three times with plain dope. The last two coats are doctored with aluminum powder, to produce the beautiful silvery surface.

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1/8 sq.x36" balsa, 8 for 5c	Light Mino tissue, 3 for 10c

Add 10c for postage and packing.
Send 2c stamp for price list.

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A popular cabin model with 24" wing spread, and 1½ to 2 min. endurance. It is an indoor and outdoor flyer and can be flown from the ground or hand launched. Complete kit, including semi-finished prop, instructions and full size plans. Postpaid $1.

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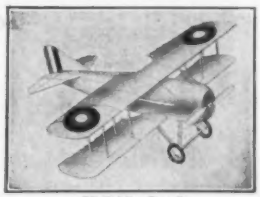

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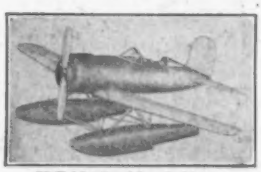

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15 in. Wing Span

all in One Construction Kit $1.50

for only
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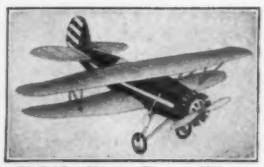
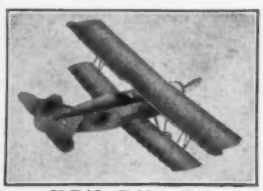


IDEAL Waco Taper Wing Biplane
15 in. Wing Span



IDEAL Fokker D-7
15 in. Wing Span

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Look at the pictures of these three world-known ships, shown above. There's Lindbergh's Lockheed Sirius that carried him to Japan, the French war-time Spad and the Vought Corsair Navy Plane—three fine ships any Model Builder will be proud to own. They're full-fuselage Models, perfect in every detail and the neatest job you ever saw! You get all three Planes in the Newest IDEAL 3-in-1 Kit No. 3. You can build them easily and quickly.

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Your choice of three separate Kits, each containing three modern, well-known Planes. All three Kits are listed here; select the one you like best and send along your order now. You can build them in a hurry, fly them repeatedly and use them for exhibition purposes. Be sure to mention which Kit you want, No. 1, No. 2, or No. 3.

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DeHAVILAND-4 BATTLE PLANE

Nicknamed the "Flaming Coffin." Model is ¾" scale—span 31⅞"; length 22¼", weight 3.9 oz. Colored all yellow and black. Complete **Kit SF-3**, only **$3.50** postfree. (Special Delivery, 15c extra). Study the details—bombs, guns, radiators, etc. All Cleveland-Designed drawings show everything full size with every detail that may be practically modeled. Every one will fly successfully at scale speeds when built from our complete kits.

CURTISS HELL DIVER

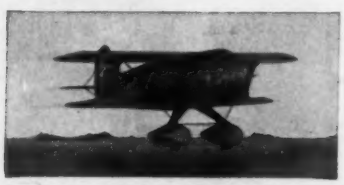
This model of the famous power-diver is ¾" scale, and span of 23⅞", length 16½", weight 2.7 oz. Colored (representing silver) natural wings, and horizontal tail; blue fuselage, struts, fin, rudder and wheel shoes; black details. Complete **Kit SF-7**, only **$3.50** postfree. (Special Delivery, 15c extra.)

SOPWITH CAMEL

One of the famed English R A F wartime ships. ¾" scale. Span 20⅞", length 14⅛", weight 1.8 oz. Colored orange wings, green stabilizer and part of fuselage; most of fuselage orange; green struts, black details. Complete **Kit SF-10**, only **$2.50**, postfree. (Special Delivery, 15c extra.)

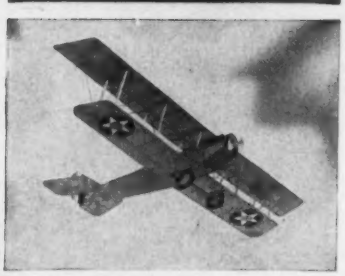
The Polish P.6. Fighter

Reputed to be one of the world's most efficient military aircraft, this airplane wih its graceful gull wing and beauiful lines deserves authentic reproduction. Model will tear along at a high speed covering great distances, often over 500 feet. ¾ in. scale. Span 25⅛ in., length 17½ in., weight 2.3 oz. Colored entirely yellow, details black, red and white Polish insignia. Complete **Kit SF-6**, only **$2.95** postfree. (Special Delivery 15c. extra.)



LAIRD SUPER-SOLUTION

Major Jimmy Doolittle's 11-hour-and-15-minute Coast to Coast record breaker! Model is ¾" scale. Flies over 500 feet, about 35 m.p.h. Span 15½", length 13¼", weight 1.7 oz. Colored yellow and green. Complete **Kit SF-5** only **$2.50** postfree. (Special Delivery, 15c. extra.)



Every picture on this page is an actual photograph of the Cleveland-Designed model itself (not the big ship it represents), superimposed on realistic backgrounds, in some instances.

CURTISS JN-4 TRAINING PLANE

The ship in which many of our war pilots learned to fly. Model is ¾" scale. Span 23⅝", length 20⅝", weight 2.7 oz. Colored all yellow with black equipment and trimmings. Complete **Kit SF-4**, only **$2.95** postfree. (Special Delivery, 15c. extra.)

NEW BOEING FIGHTER

Now widely used in U. S. Air Services, and is sometimes called Boeing's Helldiver. ¾" model has span of 22⅜", length 14¼", weight 2.0 oz. Colored yellow, green and black. Complete **Kit SF-8**, only **$2.95**, postfree. (Special Delivery, 15c extra.)

SE-5 (Sopwith Experimental-5)

Another famed English R A F wartime ship. ¾" scale. Span 20", length 15¾", weight 1.9 oz. Colored ivory and black. Complete **Kit SF-9**, only **$2.25**, postfree. (Special Delivery, 15c extra.)

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at once for illustrated Jumbo Folder, crammed full of large pictures of Cleveland-Designed models—36 of 'em! All the high quality supplies we stock are listed, too. If you want a copy of our No. 8 catalog when it comes off the press—send 25c now for your reservation. As soon as the catalog is ready (about February or March) your copy will be rushed to. (Old customers, please have patience—for the Jumbo folder we sent you replaces it temporarily).

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